CONNECTICUT RIVER FLOOD CONTROL PROJECT

NORTHAMPTON, MASS.

CONNECTICUT AND MILL RIVERS, MASSACHUSETTS

SPECIFICATIONS

FOR

LOCAL PROTECTION WORKS

FISCAL YEAR 1939 UNIT, ITEM N 3b
DIVERSION CANAL AND DIKE ALONG
EAST BANK MILL RIVER - CONTRACT

DROP STRUCTURE, BRIDGE & MISCEL. ITEMS

WAR DEPARTMENT CORPS OF ENGINEERS, U.S. ARMY

U.S. ENGINEER OFFICE, PROVIDENCE, R.I.

Invitation No. 699-39-325

WAR DEPARTMENT
UNITED STATES ENGINEER OFFICE
PROVIDENCE, RHODE ISLAND

June 12, 1939

ADDENDUM NO. 1 to Invitation No. 699-39-325, dated May 29, 1939, for construction of a portion of the diversion canal for the Mill River, Northampton, Massachusetts, bids to be opened 2 P.M., June 20, 1939.

1. Delete Paragraph 1-40, page 20 of Section I of the specifications.

2. This Addendum must be attached to and made a part of your proposal.

J. S. BRAGDON
Lieut. Col., Corps of Engineers
District Engineer

CONNECTICUT RIVER FLOOD CONTROL PROJECT

SPECIFICATIONS

FOR CONSTRUCTION OF

A PORTION OF THE DIVERSION CANAL FOR THE MILL RIVER

NORTHAMPTON, MASSACHUSETTS

MAY 29, 1939.

CORPS OF ENGINEERS, U. S. ARMY

U. S. ENGINEER OFFICE PROVIDENCE, R. I.

No. _____ Bidder _____ Invitation No. 699-39-325
(Do not write above this line)

STANDARD GOVERNMENT FORM OF INVITATION FOR BIDS
(Construction Contract)

War Department,
United States Engineer Office,
Providence, R. I.
May 29, 1939.

SEALED BIDS, in duplicate, subject to the conditions contained herein, will be received until 2 P. M., Daylight Saving Time, June 20, 1939, and then publicly opened, for furnishing all plant, labor and materials and performing all work for the construction of a portion of the diversion canal for the Mill River at Northampton, Massachusetts.

I. THE WORK shall be in strict accordance with the specifications, bidding schedule and drawings, designated as follows:

Specifications for constructing a portion of the diversion canal for the Mill River in Northampton, Massachusetts.

The drawings which will become a part of this contract are designated in Paragraph 1-04 of the specifications. Where copies of drawings are requested a deposit of $10.00 will be required to insure their return. This deposit should be in the form of a United States money order or a certified check, made payable to "The Disbursing Officer, U. S. Engineer Office, Providence, Rhode Island". The $10.00 deposit for each complete set of drawings will be refunded upon return of said drawings in good condition within 60 days after date of opening bids.

II. GUARANTEE will be required with each bid as follows: Bid bond, Standard Form No. 24, will be executed in a penal sum approximately equal to and not less than ten (10) per cent of the total amount of the bid. Individual sureties will justify in sums aggregating not less than double the penalty of the bid bond. (See Paragraphs 8 to 11, inclusive, of Instructions to Bidders). Certified check may be furnished in lieu of bid bond.

III. PERFORMANCE AND PAYMENT BONDS will be required from the successful bidder as follows:

a. A performance bond with good and sufficient surety or sureties, for the protection of the United States, Standard Form No. 25, will be executed in a penal sum approximately equal to and not less than fifty (50) per cent of the full amount of the consideration of the contract.

b. If the consideration of the contract will exceed $2,000.00 in amount, a payment bond with good and sufficient surety or sureties, for the protection of persons furnishing material and labor for the work, Standard Form No. 25-A, will be executed in a penal sum approximately equal to and not less than fifty (50) per cent of the full amount of the consideration of the contract when the latter is not more than one million dollars ($1,000,000.00; forty (40) per cent where the contract exceeds one million dollars ($1,000,000.00) but is not more than five million dollars ($5,000,000.00); and two million five hundred thousand dollars ($2,500,000.00) for all contracts above five million dollars ($5,000,000.00).

IV. LIQUIDATED DAMAGES for delay will be prescribed. (See Paragraph 1-07 of the specifications).

V. TAX ADJUSTMENTS. - Provisions for tax adjustments will be made a part of the contract. (See Paragraph 1-12 of the specifications).

VI. PARTIAL PAYMENTS will be made. (See Article 16 of the contract and Paragraph 1-10 of the specifications).

VII. ARTICLES ON PATENTS will be made a part of the contract. (See Paragraph 1-16 of the specifications).

VIII. BID AND CONTRACT. - a. Bids must be submitted upon the Standard Government Form of Bid and the successful bidder will be required to execute the Standard Government Form of Contract for construction. The bid form has an entry for each item on which estimates will be given or payment made, and no other allowances of any kind will be made unless specifically provided for in the specifications or the contract. A bid for the entire work must have each blank filled, except that bids may be submitted for either Item 5 or Item 5A, or both.

b. The quantities of each item of the bid, as finally ascertained at the close of the contract, in the units given and the unit prices of the several items stated by the bidder in the accepted bid, will determine the total payments to accrue under the contract. The unit price bid for each item must allow for all collateral or indirect cost connected with it.

c. The successful bidder will be required to return the contract duly executed and to furnish the performance and payment bonds hereinbefore described, within ten (10) days after the papers are presented to him.

IX. EXPERIENCE. - a. Each bidder shall state in his bid whether he is now or ever has been engaged on any contract or other work similar to that proposed, giving the year in which it was done and the manner of its execution, and shall submit such other information as will tend to show his ability to prosecute vigorously the work required by these specifications.

b. Each bidder shall submit with his bid a list of the number of persons expected to be employed on the work in each class as contained in Paragraph 1-30 of the specifications, and the number of months they will be employed.

X. COMMENCEMENT AND COMPLETION. - Work shall be commenced within ten (10) calendar days after receipt of notice to proceed and shall be completed within 150 calendar days, in accordance with the provisions of Paragraph 1-07 of the specifications.

XI. MINIMUM WAGE RATES for the locality of the work have been determined by the U. S. Department of Labor, and proof of payment of such wages will be required. (See Articles 17 and 19 of the contract and Paragraph 1-35 of the specifications).

XII. ARTICLES ON RELIEF LABOR will be made a part of the contract (see Paragraph 1-30 of the specifications).

XIII. EIGHT-HOUR LAW. - The requirements of the Eight-Hour Law, Article 11, of the contract, will be applicable to the work under the contract.

XIV. ARTICLES ON PREFERENCE for domestic materials will be made a part of the contract. (See Article 18 of the contract and Paragraph 1-31 of the specifications).

XV. REPORTS TO THE DEPARTMENT OF LABOR. - In order to assist the Department of Labor in obtaining employment statistics, bidders, unless otherwise indicated in their bids, will be considered as having voluntarily consented, without cost to the Government, to the inclusion of Paragraph 1-36 of the specifications as a part of the contract.

XVI. INVESTIGATION OF CONDITIONS. - Samples of borings and from test pits taken at the site of the work can be seen at the U. S. Engineer Laboratory at Providence, R. I., where they should be inspected by prospective bidders. Bidders are expected to visit the locality of the work and acquaint themselves with all available information concerning the nature of the materials to be excavated from the borrow or structure excavations, the nature of the materials to be transported and placed in the embankment and the local conditions bearing on transportation, handling and storage of materials. They are also expected to make their own estimates of the facilities needed, the difficulties attending the execution of the proposed contract, including local conditions, availability of labor, uncertainties of weather, and other contingencies. In no case will the Government assume any responsibility whatever for any interpretation, deduction, or conclusion drawn from the examination of the site. At bidder's request a representative of the Government will point out the site of the proposed operations. Failure to acquaint himself with all available information concerning these conditions will not relieve the successful bidder of assuming all responsibility for estimating the difficulties and costs of successfully performing the complete work.

XVII. FACILITIES AVAILABLE FOR CONSTRUCTION are described in Paragraph 1-06 of the specifications.

XVIII. DATA TO BE SUBMITTED WITH BIDS. - a. Each bidder shall submit with his bid, drawings showing proposed plant layout and charts showing the rate of progress the bidder will maintain on the work, carefully prepared and presented in neat and legible form. These data are considered essential in assisting the contracting officer to determine whether or not the bidder is responsible, experienced in similar types of construction, and that his bid is based on a careful study of construction methods applicable to the work, and with a full realization of the various factors which may affect its progress.

b. The drawings indicating the plant layout shall clearly show the location and manner of employment of the various major items of plant, the method of excavation and disposal of materials, and the manner in which structural features will be erected.

c. The progress charts shall indicate the volume of work to be done and the rate of progress which the bidder agrees to maintain for each of the following major operations required in the performance of the work under these specifications: Excavations, Pile driving and concreting. These charts may be in any convenient form in which the time element shall be plotted to represent definite intervals of time measured from date of notice to proceed with the work, and the volume of work shall be represented by a suitable scale of percentage of completion based on the estimated contract quantities. Careful consideration shall be given to the preparation of the charts as the contractor will be required to maintain the rate of progress indicated thereon.

XIX. PLANT. - Each bidder shall state in his bid the character and amount of plant that he proposes to employ on the work. After bids are opened any bidder may be required to show that he owns, controls or can procure the plant necessary for commencing, prosecuting, and completing the work as required by the specifications.

XX. AWARD OF CONTRACT. - a. Subject to the rights hereinafter reserved, the work will be awarded as a whole to the lowest bidder whose proposal fully conforms to the requirement of the specifications and as may be deemed most advantageous to the Government. The right is reserved as the interest of the Government may require, to reject any and all bids, to waive any informality in bids received, unless such bid is qualified by specific limitation.

b. A bid may be rejected if the bidder cannot show that he has the necessary capital and experience, and owns, controls or can procure the necessary plant to commence the work at the time prescribed in the specifications and thereafter to prosecute and complete the work at the rate or time specified; and that he is not already obligated for the performance of other work which would delay the commencement,

prosecution or completion of the work contemplated in this advertisement.

c. Any unbalanced bid which, in the opinion of the contracting officer, jeopardizes the interest of the Government will be subject to rejection for that reason.

XXI. ADDRESS FOR BIDS. - Bids submitted must be in envelopes with sufficient postage, sealed, marked and addressed as follows:

(Marked in upper left-hand corner)

Bid for construction of a portion of the diversion canal for the Mill River at Northampton, Mass. To be opened June 20, 1939.

(Addressed to)

District Engineer,
United States Engineer Office,
819 Industrial Trust Bldg.,
Providence, R. I.

Note: - See Standard Government Instructions to bidders and copy of the Standard Government Forms of contract, bid bond, payment bond, and performance bond, which may be obtained upon application.

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SPECIFICATIONS

SECTION I. GENERAL PROVISIONS.

DETAILED SPECIFICATIONS

Invitation No. 699-39-325

WAR DEPARTMENT
UNITED STATES ENGINEER OFFICE
PROVIDENCE, RHODE ISLAND

APPROPRIATIONS: 713022-658/9999-Emergency Relief, War, Corps of Engineers, Public Buildings, Parks, Utilities, Flood Control, etc. (Transfer from WPA), 1938-1939.
21-408/00583 Public Works Administration Act of 1938 (Allotment to War, Flood Control), 1938-1940.

DIVERSION CANAL FOR THE MILL RIVER AT NORTHAMPTON, MASSACHUSETTS

SPECIFICATIONS

SECTION I. GENERAL PROVISIONS

1-01. Location. - The site of the work covered by these specifications is located in the southwest portion of the City of Northampton, Massachusetts.

1-02. Work to be done. - a. The work provided for herein is authorized by the Flood Control Act of June 28, 1938 (Public No. 761, 75th Congress).

b. The work to be done under the contract consists of furnishing all plant, labor and materials and performing all work required for constructing a portion of the Mill River Diversion Canal and all appurtenant structures, complete in accordance with these specifications and the drawings forming a part hereof, together with such incidental work as needed or ordered in writing by the contracting officer. It will consist of the following principal items of construction:

(1) Excavation of canal between Station C28+00 and C35+00.

(2) Construction of a concrete drop structure, concrete bridge and concrete canal walls.

(3) Relocation, grading and surfacing of roads as follows:

(a) South Street (State Highway No. 10) - Station R-0+50 to Station R-15+00.

(b) Earle Street - Station 0+00 to Station 8+47.

(c) Pyncheon Meadow Road - Station 0+00 to Station 8+20.

(d) Detour Roadway - Station 0+00 to Station 4+37.

1-03. Description of work. - a. Excavation of 700 linear feet of the diversion canal is included in this contract, the bottom width of which varies between 35 feet and 100 feet, and the maximum depth of which is 35 feet.

b. The drop structure, bridge and walls will be reinforced concrete founded on timber piling. The drop structure will include concrete paving of the canal floor, a concrete weir of the ogee type with drains and two stop-log openings, a stilling basin, and a steel sheet pile cut-off at each end of the structure. The bridge will be a two-span, four-lane, reinforced concrete, simple beam type provided with sidewalks on each side of the roadway, the total length of which is 100 feet. The canal walls will have a total length of approximately 560 feet, the height of which will vary between zero and 30 feet.

c. The highway relocation will include approximately 2,800 linear feet of roadway grading, 335 linear feet of concrete pavement and 1,700 linear feet of bituminous macadam pavement.

1-04. Drawings. - a. The work shall conform to drawings marked "Northampton Dike - Diversion Canal - Fiscal Year 1939 Section," as listed below, which drawings form a part of these specifications and are filed in the United States Engineer Office, Providence, Rhode Island.

LIST OF DRAWINGS

Sheet No.	Title	File No.
1	Location and Index	CT-4-1641
2	Subsurface Explorations	CT-2-1167
3	General Plan	CT-4-1642
4	Plan and Profile, No. 1	CT-4-1643
5	Plan and Profile, No. 2	CT-4-1644
6	Typical Sections	CT-4-1645
7	Earle and South Streets - Relocations	CT-4-1646
8	Earle and South Streets - Sections	CT-4-1647
9	Earle and South Streets - Details	CT-4-1648
10	Drainage and Guard Rail Details	CT-4-1649
11	Pyncheon Meadow Road	CT-4-1650
12	South Street Bridge, General Plan and Profile	CT-4-1651
13	South Street Bridge, Abutments	CT-4-1652
14	South Street Bridge, Details No. 1	CT-4-1653
15	South Street Bridge, Details No. 2	CT-4-1654
16	South Street Bridge, Steel Reinforcement No. 1	CT-4-1655
17	South Street Bridge, Steel Reinforcement No. 2	CT-4-1656
18	South Street Bridge, Steel Reinforcement No. 3	CT-4-1657
19	South Street Bridge, Steel Reinforcement No. 4	CT-4-1658
20	South Street Bridge, Steel Reinforcement No. 5	CT-4-1659
21	South Street Bridge, Reinforcement Schedule No. 1	CT-4-1660
22	South Street Bridge, Reinforcement Schedule No. 2	CT-4-1661

Sheet No.	Title	File No.
23	Drop Structure, Plan and Profile	CT-4-1662
24	Drop Structure, Timber Piling Plan	CT-4-1663
25	Drop Structure, Timber Piling Sections	CT-4-1664
26	Drop Structure, Weir Crest and Pier	CT-4-1665
27	Drop Structure, Drains and Joints	CT-4-1666
28	Drop Structure, Developed Walls	CT-4-1667
29	Drop Structure, Concrete Details and Sections, No. 1	CT-4-1668
30	Drop Structure, Concrete Details and Sections, No. 2	CT-4-1669
31	Drop Structure, Steel Sheet Piling	CT-4-1670
32	Drop Structure Walls, Steel Reinforcement No. 1	CT-4-1671
33	Drop Structure Walls, Steel Reinforcement No. 2	CT-4-1672
34	Drop Structure Walls, Steel Reinforcement No. 3	CT-4-1673
35	Drop Structure Walls, Steel Reinforcement No. 4	CT-4-1674
36	Drop Structure Walls, Steel Reinforcement No. 5	CT-4-1675
37	Drop Structure Walls, Steel Reinforcement No. 6	CT-4-1676
38	Drop Structure Walls, Steel Reinforcement No. 7	CT-4-1677
39	Drop Structure Floor, Steel Reinforcement No. 1	CT-4-1678
40	Drop Structure Floor, Steel Reinforcement No. 2	CT-4-1679
41	Drop Structure Walls, Reinforcement Schedule No. 1	CT-4-1680
42	Drop Structure Walls, Reinforcement Schedule No. 2	CT-4-1681
43	Drop Structure Walls, Reinforcement Schedule No. 3	CT-4-1682

b. The work shall also conform to such other drawings relating thereto as may be exhibited in the office of the contracting officer prior to the opening of proposals and to such drawings used in explanation of details as may be required from time to time during construction, including such minor modifications as the contracting officer may consider necessary on account of conditions discovered during the prosecution of the work.

c. Prior to performing the work, the contractor shall check all drawings and shall immediately report to the contracting officer any errors or omissions discovered therein. Quantities stated in bills of material on Government drawings are approximate only. The contractor shall be responsible for furnishing the required quantity without change in unit price. All items to be furnished at lump sum prices shall be provided by the contractor, complete and in good working order, regardless of whether or not they are fully shown or listed on the contract drawings. Parts and details not fully indicated on the drawings shall be detailed by the contractor in accordance with the best engineering practice, and 4 copies of each drawing shall be submitted to the contracting officer for approval. Each sheet of drawings submitted for approval shall be provided with a blank white space approximately 5 inches by 4 inches near the lower right-hand corner, just above the title, in which the contracting officer may indicate the action taken. After approval by the contracting officer, but before the work indicated on the contractor's drawings is commenced, one copy of each approved drawing will be furnished the contractor. These approved drawings shall form a part of the contract. The Government will not be responsible for minor errors or minor discrepancies of the contract

drawings. Drawings furnished by the contractor for approval by the contracting officer shall be made with ink on tracing cloth. Upon completion of the project, the contracting officer shall be furnished with "Van Dyke" negatives of the contractor's drawings, corrected to show all revisions made during construction.

d. Ten sets of prints of all necessary drawings will be furnished the contractor without charge. Additional prints will be furnished upon request at the cost of printing.

1-05. Quantities. - The following estimate of quantities is given to serve as a basis for the comparison of bids and to determine the approximate amount of the consideration of the contract. Within the limits of available funds, the contractor will be required to complete the work specified in Paragraph 1-02 hereof, whether it be more or less than that estimated, and final payment will not be made until the work is so completed.

LIST OF QUANTITIES

Item No.	Designation	Unit	Quantity
1	Preparation of Site	acres	6.25
2	Stripping	cu.yds.	6,100
3	Excavation, Common	" "	75,600
4	Steel Sheet Piling	sq.ft.	14,100
5	Timber Piling	lin.ft.	27,900
5A	(Alternate to Item 5)		
	(1) Timber Piling	" "	20,200
	(2) Reinforced Concrete Piling	" "	3,850
6A	Screened Gravel	cu.yds.	900
6B	Crushed Stone	" "	150
7	Compacted Backfill	" "	2,000
8	Semi-compacted Backfill	" "	5,200
9	Highway Embankment	" "	10,000
10	4-Inch Tile Pipe	lin.ft.	1,030
11	Corrugated Metal Pipe		
	a. 18-Inch	" "	41
	b. 36-Inch	" "	70
12	Riprap		
	a. Derrick Stone	cu.yds.	1,140
	b. Hand Placed	" "	400
13	Cement	bbls.	6,600
14	Steel Reinforcement	lbs.	440,000
15	Class A Concrete in Bridge	cu.yds.	530
16	Class A Concrete in Highways	" "	350
17	Class B Concrete	" "	4,710
18	Pipe Hand-railing		
	a. Canal Walls	lin.ft.	385
	b. Bridge	" "	175
19	Miscellaneous Iron and Steel	lbs.	14,600

Item No.	Designation	Unit	Quantity
20	Copper Water Stops	lbs.	765
21	Phosphor-Bronze Plates	"	160
22	Sheet Lead	"	1,300
23	Surfacing for Roads	cu.yds.	2,900
24	Bituminous Macadam Surface	sq.yds.	4,300
25	Highway Guard Rail	lin.ft.	470
26	Precast Concrete Stop-Logs	" "	106

1-06. Physical data. - a. General. - Borings and test pits have been made in the vicinity of the proposed work with reasonable care and substantially at the places indicated on the drawings. Laboratory analyses have been made of the samples from many bore holes and test pits. Samples of materials taken from them, and records of laboratory analyses and other studies may be seen at the United States Engineer Office, Providence, Rhode Island. It is expressly understood that Government will not be responsible for any deduction, interpretation, or conclusions made by the contractor from his inspection of the available samples and records. These samples of materials and contract drawings represent all the pertinent information on subsurface exploration which the Government has made at the site. Concrete aggregates will be obtained from approved commercial sources.

b. Transportation facilities. - (1) Railroads. - The New York, New Haven and Hartford and Boston and Maine Railroads serve the City of Northampton with main line traffic. The contractor shall investigate the availability of the sidings from the railroad company and make all arrangements with the latter for the use of any sidings for the delivery of any materials and equipment to be used on the work.

(2) Highways. - First-class highways also serve the city. The contractor shall provide for his own construction or access roads and their maintenance. He shall make his own investigation of available roads for transportation, of load limits for bridges and roads, and other road conditions affecting the transportation of materials and equipment to the site of the work.

(3) Maintenance of highway traffic. - Traffic on State Highway Route No. 10 shall be maintained and protected by the contractor for the duration of the contract. The detour road shall be constructed as shown on the drawings and maintained in good condition during its period of use. Upon completion of the new bridge and roadway, the contracting officer will issue written authority for rerouting traffic back to the relocated highway and for the removal of the detour road.

c. Weather conditions. - The locality is subject to atmospheric temperatures ranging from minus 26 degrees to plus 104 degrees Fahrenheit. The mean annual precipitation at Northampton is 43.81 inches. The mean monthly precipitation varies from a low of 3.18 inches in February to a high of 4.26 inches in July.

1-07. Commencement, prosecution, and completion. - a. The contractor will be required to commence the work under the contract within ten (10) calendar days after date of receipt by him of notice to proceed, to prosecute the said work with faithfulness and energy, and to complete the entire work within 150 calendar days after said date of receipt of notice to proceed.

b. Liquidated damages. - In case of failure on the part of the contractor to complete the work within the time determined and agreed upon for its completion plus any extensions duly granted under the terms of the contract, the contractor shall pay the Government as liquidated damages for delay in completing the entire work under the contract, the sum of fifty dollars ($50.00) for each calendar day of delay until all work is completed or accepted.

1-08. Sundays, holidays, and nights. - No work shall be done on Sundays or on days declared by Congress as holidays for per diem employees of the United States except in cases of emergency, and then only with the written consent of the contracting officer. Work may be done at night when authorized in writing by the contracting officer.

1-09. Progress, organization, and plant. - a. The contractor shall employ at all times, an ample force of men with proper experience in their respective assignments, and provide equipment and a construction plant properly adapted to the work, and of sufficient capacity and efficiency to accomplish the work in a safe and workmanlike manner at the rate of progress stated in his bid and specified herein. All plant and equipment shall be maintained in good working order, and provision shall be made for immediate emergency repairs. The contracting officer may order the removal and require replacement of any unsatisfactory plant or equipment. No reduction in the capacity of the plant employed on the work shall be made, except under written permission of the contracting officer. The measure of "capacity of the plant" shall be its actual performance on the work to which these specifications apply. It is understood that award of this contract shall not be construed as a guarantee by the United States that the plant and equipment listed by the contractor in the bid form is adequate for the performance of the work.

b. Should the contractor fail to maintain the rate of progress proposed in his bid and specified herein, the contracting officer may require that additional men, equipment or plant be placed on the work, or a reorganization of plant layout be effected in order that the work be brought up to schedule and maintained there. Should the contractor refuse or neglect to comply with these requirements to the satisfaction of the contracting officer, the contracting officer will proceed under the provisions of Article 9 of the contract.

1-10. Payments. - Payments will be made monthly in accordance with Article 16 of the contract for work executed and completed as specified

or otherwise required, and not included in any prior estimate, except that 10 per cent of the amount of each estimate will be retained until the contract work is 50 per cent completed, and thereafter with each monthly payment there will be paid such portion of the amount so retained as in excess of 10 per cent of the estimated cost of completing the work remaining to be done, until the amount retained is reduced to $10,000, after which the amount to be retained will remain unchanged until the completion of the contract.

1-11. Work covered by contract price. - The contractor shall, under his contract prices, furnish and pay for all material and labor, and all permanent, temporary, and incidental work, furnish all accessories, and do everything that may be necessary to carry out the work specified in good faith, which contemplates everything specified completed, of good materials with accurate workmanship, skillfully fitted and properly connected and put together.

1-12. Tax adjustments. - The contract price will be considered to include all Federal, State and local taxes imposed prior to the date of opening bids and applicable to the undertaking. If any privilege, sales, gross receipt or other tax (exclusive of taxes on net income or undistributed profits) applicable to the undertaking and payable directly by the contractor, is imposed or changed after the date of opening bids by Federal or State enactment, then the contract price will be increased or decreased accordingly, and any amount due or chargeable against the contractor as a result thereof will be adjusted on payment vouchers as separate items.

1-13. Material to be furnished by the contractor. - The contractor shall furnish all materials and equipment, necessary to complete the work to be done under these specifications. The cost of unloading and loading, handling, hauling, storing and caring for materials furnished by the contractor shall be included in the contract prices for the work to which the materials pertain. All materials, supplies and articles delivered at the site shall be adequately housed or otherwise protected against deterioration and damage. When material stored at the site and partly paid for is not adequately protected by the contractor, such material will be kept protected by the contracting officer, at the expense of the contractor, and no further partial payments will be made thereon.

1-14. Order of work. - The work shall be carried on at such places and also in such order of precedence as may be found necessary by the contracting officer. The contractor shall submit, for approval of the contracting officer, his proposed program in writing giving the sequence of construction operations contemplated. The location and limits of the work to be done will be plainly indicated by stakes, lines, marks or otherwise as established by the contracting officer or his agents.

1-15. Damage. - Damage to Government property due to the failure of the contractor to take reasonable precaution, and all loss or deteriora-

tion of, or damage to any of the work by flood, accident or exposure prior to final acceptance of the work, shall be made good by the contractor without expense to the Government.

1-16. Patents. - The contractor shall hold and save the Government, its officers, agents and employees harmless from liability of any nature or kind, including costs and expenses, for or on account of any patented or unpatented process, or invention, article, or appliance manufactured or used in the performance of this contract, including its use by the Government.

1-17. Grounds and right of way. - a. Grounds and right of way, needed for the work to be done under these specifications, will be furnished by the Government. The Government will not be held liable for any delay in furnishing the grounds or right of way, but in case such delay retards the operations of the contract, the contracting officer will grant an extension of time for the completion of the work equal to the time of the delay (see Paragraph 1-07). The contractor will have the privilege of using the Government controlled land at the site, not otherwise reserved by the contracting officer, provided, that plans for all construction, storage, or other operations proposed thereon by the contractor are submitted for approval of the contracting officer, prior to the occupation of such areas.

b. The contractor, without expense to the Government, at any time during the progress of the work and when space is needed for other purposes, shall vacate promptly and clean up any part of the grounds allotted to or in use by him, when directed to do so by the contracting officer.

1-18. Removal of rubbish. - The contractor shall keep the site free from rubbish. Suitable spoil areas for receiving refuse from the grounds shall be provided, and the rubbish shall be removed and disposed of as directed by the contracting officer. At the conclusion of the work, the site shall be cleaned up and all rubbish and unused materials shall be disposed of in accordance with Paragraph 10-05.

1-19. Obstruction and danger lights. - In the contractor's use of streets and highways, for the work to be done under these specifications, he shall conduct his operations so as to cause no greater obstruction to the traveling public than is considered necessary by the contracting officer. The contractor shall provide, erect and maintain effective barricades, danger signals, and signs on all intercepted roads on highways, and on the site where directed by the contracting officer for the protection of the work and safety of the public. All barricades and obstructions which encroach on or are adjacent to public rights of way and all plant connected with the work when directed by the contracting officer shall be provided with lights at night and all such lights shall be kept burning between sunset and sunrise. Such barricades and lights shall conform to the local and State laws. The contractor shall be responsible for all damages resulting from any neglect or failure of these requirements. The expense of these and other safety precautions

shall be borne by the contractor. If work at night is permitted by the contracting officer, (see Paragraph 1-08) the contractor shall maintain from sunset to sunrise such lights on or about his plant as the contracting officer may deem necessary for the proper observation and execution of the work.

1-20. Inspection and supervision. - a. General. - The work will be conducted under the general direction of the contracting officer, and will be inspected in accordance with Article 6 of the contract, by inspectors appointed by him. The inspectors so appointed will be authorized to reject material or work which, in their opinion, does not conform to the requirements of the specifications. Any rejected material shall be removed from the site without delay, and any defective work shall be replaced. The contracting officer will furnish on request of the contractor all location and limit marks reasonably necessary as provided in Paragraph 1-22. The inspectors will keep a record of work done, and see that the location and limit marks are kept in proper order; work done without proper inspection may not be paid for. The presence of an inspector shall not relieve the contractor of his responsibility for the superintendence required in the proper execution of the work (see Article 8 of the contract). Tests to determine the quality and fitness of material used and work done under these specifications will be made as indicated under that part of the specifications pertinent to the particular kind of work, and as stated in Paragraph 1-37.

b. Facilities to be furnished. - (1) The contractor shall furnish promptly, in accordance with Article 6 of the contract, all reasonable facilities, labor, and materials necessary for the safe and convenient inspection and tests that may be required by the contracting officer and his inspectors.

(2) The contractor shall furnish a room approximately 8 feet by 12 feet in size at his concrete mixing plant for a Government laboratory, to be used for making field tests including the moisture content of aggregates and such other field tests as are prescribed in these specifications under Section VII and for temporary storage of concrete specimens. The room shall be protected from the weather, properly lighted, and heated, all of which together with the location and capacity will be subject to the approval of the contracting officer. The contractor shall provide electricity in accordance with Paragraph 1-34.

(3) The contractor shall furnish appropriate quarters for a Government field office. Such quarters shall be a room approximately 12 by 20 feet in size, and otherwise shall conform to the provisions of subparagraph (2) above.

(4) No separate payment will be made to the contractor for providing these facilities. Should the contractor refuse, neglect, or delay compliance with the requirements concerning facilities for inspection, the specific facilities may be furnished and maintained by the

Government, and the cost therefor will be deducted from any amounts due to or to become due the contractor.

c. It is hereby understood and agreed that any instructions or decisions by a superior officer through the contracting officer are to be considered instructions or decisions of the contracting officer in all cases under the terms of the contract where decision rests with the contracting officer.

1-21. Datum and bench marks. - The plane of reference used in these specifications and on the drawings hereof is mean sea level datum. Elevations in feet as specified and as shown on the drawings are to be determined from a bench mark located at the site of the work, the location, description, and elevation (in feet) of which is as follows:

> A standard U.S.C. & G.S. Disk #9XLCS set in concrete post flush with ground: 1¾ feet North of Boston & Maine signal tower, 167 feet south of Hockanum Road and 7 feet east of east rail.
>
> Elevation 120.627 feet, M.S.L.

1-22. Lines and grades. - a. The contractor shall keep the contracting officer informed a reasonable time in advance of the time and places at which he intends to do work in order that lines and grades may be given, necessary measurement for record and payment made and progress photographs taken with a minimum of inconvenience to the contracting officer or of delay to the contractor, and the contractor shall have no claim for damages or extension of time on account of delays in the giving of lines and grades or due to destruction of such marks and the consequent necessity for replacement. Whenever the contracting officer finds it necessary to carry on his operations on Sundays, legal holidays or at other times when the work of the contractor is not in progress, the contractor shall furnish all necessary service and assistance. No direct compensation will be made for the cost to the contractor for any of the work or delay occasioned by giving lines and grades or making other necessary measurements or by inspection, but compensation shall be considered as having been included in the contract prices.

b. All lines and grades will be given by the Government inspectors as authorized representatives of the contracting officer, but the contractor shall provide at his own expense such temporary structures and such materials and give such assistance as may be required by the contracting officer and the marks given shall be carefully preserved. After lines, elevations and grades for any part of the work have been given by the contracting officer, the contractor will be held responsible for the proper execution of the work to such lines, elevations, and grades, and all stakes or other marks given shall be preserved by the contractor until they are authorized to be removed by the contract-

ing officer. The contracting officer may require the work to be suspended when for any reason such marks cannot be properly followed.

1-23. Interpretation of specifications. - The contracting officer shall decide all questions which may arise as to the performance, quantity, quality, acceptability, fitness, and rate of progress of the several kinds of work to be done or materials to be furnished under this contract. He shall decide all questions which may arise as to the interpretation of the specifications and of drawings used and as to the fulfillment of this contract on the part of the contractor, and as to defects in the contractor's work. His determination and decision shall be final, subject to appeal as provided for in Article 15 of the contract.

1-24. Spoil Areas. - Spoil areas will be furnished by the local interests without cost to the contractor, including rights of way for transportation purposes across property not owned. If sufficient area is not available in the spoil areas indicated on the drawings or otherwise provided to complete the work, additional areas will be furnished without cost to the contractor.

1-25. Water supply. - The contractor shall provide, at convenient points, ample supplies of water of proper quality for all the operations required under this contract.

1-26. Use of explosives. - The contractor shall use the utmost care in the use of explosives necessary for the prosecution of the work, not to endanger life or property. All blasting operations shall be conducted by experienced men only. The handling and use of explosives shall be done strictly in accordance with the latest methods and rulings to insure safety; in accordance with the specifications issued by the United States Bureau of Mines; and in compliance with the local and State laws. Failure to observe necessary precautions will be sufficient grounds for temporary suspension of the work. All explosives shall be transported and stored in a secure manner, and in accordance with local and State laws; all vehicles and such storage places shall be marked clearly "DANGEROUS - EXPLOSIVES," and shall be in care of competent watchmen at all times. In no case shall caps or other detonators be stored or transported with dynamite or other explosives. The location of magazines for the storage of explosives and for the separate storage of detonators shall be subject to the approval of the contracting officer.

1-27. Standard stock products. - All material, supplies and articles furnished shall, wherever so specified and otherwise wherever practicable, be the standard stock products of recognized reputable manufacturers. The standard stock products of manufacturers other than those specified will be accepted if, in the opinion of the contracting officer, they are equal in strength, durability, usefulness and convenience for the purpose intended. (See Article 7 of the contract.) Any changes required in the details and dimensions shown on the drawings for the sub-

stitution of standard stock products, other than those provided for, shall be properly made as approved by the contracting officer, and at the expense of the contractor.

1-28. Safety requirements. - a. The contractor shall make all necessary provisions to protect the public safety, and to maintain and protect existing structures of whatever kind, and shall repair all damages done to such structures. He shall give ample notification to the proper officials of any city or town and of any public utility or other corporation before entering upon their respective public ways or rights of way to perform the required work of construction. Such construction shall conform to the customary regulations and requirements of said officials or corporations. The contractor shall give all notices, take out all permits, and pay all such charges, fees, water and other rates that may be necessary in the carrying out of the work.

b. The contractor shall be responsible that his employees strictly observe the laws of the United States affecting all operations at the site under the contract. He shall comply with all applicable Federal and State laws under which he is operating, including those concerning the inspection of boilers and other equipment, the licensing of engineers, welders and other employees.

c. The contractor shall conduct the work with due regard to adequate safety and sanitary requirements and shall maintain his plant and equipment in safe condition. He shall conform to current safety engineering practices as set forth in the Manual of Accident Prevention in Construction, published by the Associated General Contractors of America; the publications of the National Safety Council, and with all applicable State or local safety and sanitary laws, regulations and ordinances.

d. The contracting officer will require such safety and sanitary measures to be taken as the nature of the work and the conditions under which it is to be performed, demand. Such measures shall include:

(1) The provisions of adequate extinguishers or fire-fighting apparatus in and about all buildings and plant erected or used at the site of the work.

(2) Adequate first aid and life-saving equipment.

(3) Adequate illumination during night operations.

(4) Instruction in accident prevention to reach all employees.

(5) Such machinery guards, safe walkways, scaffolds, ladders, bridges, gang-planks, and other safety devices, equipment and apparel as are necessary to prevent accidents or injuries.

e. The contractor shall promptly report to the contracting officer in form prescribed by him all accidents occuring at the site of the work.

f. The contracting officer will notify the contractor in writing of any non-compliance with the foregoing provisions and the corrective action to be taken. If the contractor fails or refuses to comply promptly the contracting officer may issue a stop order suspending all or any part of the work. Such stop order will be sent by registered mail to the contractor a t the site of the work and shall be accepted by him as sufficient notice thereof. Work shall thereupon be suspended as directed. When satisfactory corrective action is taken, a resumption order will be issued. No part of the time lost due to any such stop order shall be made the subject of a claim for extension of time or for excess costs or damages by the contractor.

1-29. Access to work. - The contracting officer, his authorized representative and other duly authorized agents and employees of the Government may at all times enter upon the work and premises used by the contractor, or into his works, or shops. The contractor shall provide safe and proper facilities for such entrance and for the inspection of materials and workmanship.

1-30. Special wage and labor provisions pertaining to persons employed under the provisions of the Emergency Relief Appropriation Act of 1938. - a. Employment of Relief Labor. - In addition to the funds from the Public Works Administration Act of June 21, 1938, the sum of approximately $65,000 is available for payments to the contractor from the Emergency Relief Approp riation Act of 1938. The contractor shall plan his work, and the use of machinery and equipment thereon, so as to provide the maximum employment of relief labor. Relief labor shall be employed as uniformly through the contract period as the status of the work will permit, in the opinion of the contracting officer. Except with the specific authorization of the Federal Works Progress Administrator or his representative, at least 95 per cent of the workers paid from Emergency Relief funds shall be referred for assignment to the work by such public relief agency as may be designated by the Federal Works Progress Administrator or his representative.

b. Labor preferences. - (1) Preference for employment shall be given to persons certified as in need of relief by the public relief agency approved by the Works Progress Administration.

(2) No such person under the age of eighteen (18) years, nor one whose age or physical condition is such as to make his employment dangerous to his health or safety, or the health and safety of others, may be employed under these funds. This paragraph shall not be construed to operate against the employment of physically handicapped persons, otherwise employable, where such persons may be safely assigned to work which they can ably perform.

(3) Only one such member of a family group may be employed under these funds, except as specifically authorized by the Works Progress Administration.

(4) No alien is oligible for employment under the W.P.A. program, even though he may have declared his intentions to become a citizen of the United States.

(5) From among those persons certified as in need of relief who are qualified by training, experience and ability, preference in employment shall be given in the following order:

1. Veterans of the World War and the Spanish-American War and veterans of any campaign or expedition in which the United States has been engaged (as determined on the basis of the laws administered by the Veterans' Administration) who are in need and are American citizens;

2. Other American citizens, Indians and other persons owing allegiance to the United States who are in need.

(6) Except as specifically provided above, such workers who are qualified by training and experi ence and certified for work on the project by such agency as may be designated by the Federal Administrator of the Works Progress Administration, shall not be discriminated against on any grounds whatsoever.

(7) The contractor shall maintain an up-to-date roster of all employees engaged on the project, showing their names, legal residences, and sources of employment.

c. Wages and monthly earnings. - (1) The contractor and all subcontractors shall pay all such employees directly employed on this work at the site thereof an hourly rate of pay which shall not be less than the minimum hourly rate of pay as specified in Paragraph 1-35. "The site of the Work" as used in these specifications, shall include all operations under this contract or any subcontract, involving labor and materials or labor only, regardless of location, except that operations that are part of the usual and current business of the executor and mingled with other similar work not under this contract shall not be so included. For example, the work of supplying sand and gravel from a pit that is opened up and manned s olely for work under this contract is an operation directly on the work.

(2) At least 95 per cent of such employees shall be paid in accordance with the Schedule of Monthly Earnings established by Executive Order No. 7046, dated May 20, 1935, or subsequent revisions thereof, except with the specific authorization of the Federal Works Progress Administrator or his designated representative (see sub-paragraph (5)).

(3). A clearly legible statement of all wage rates to be paid the several classes of such labor employed on the work shall be posted in a prominent and easily accessible place at the site of the w ork, and the contractor shall keep a true and accurate record of the hours worked by and the wages paid to each such employee and shall furnish the contracting officer with a sworn statement thereof on demand. All such employees shall be paid in full not less often than once each week and in l awful money of the United States in the full amount accrued to each individual at the time of closing of the payroll, which shall be at the latest date practicable prior to the date of payment, and there shall be no deductions or rebates on account of goods purchased, rent, or other obligations, but such obligations shall be subject to collection only by legal process.

(4) Wages for any such employees to be paid by, or for which reimbursement is to be made by, the Federal Government may not be pledged or assigned, and any purported pledge or assignment shall be null and void.

(5) The following Schedule of Monthly Earnings is applicable to the relief w ork under this contract (subject to authorized revisions and modifications):

(Schedule of Monthly Earnings on following page)

SCHEDULE OF MONTHLY EARNINGS

Designation	Hours to be Worked Monthly	Maximum Monthly Earnings
Air Tool Operator (jackhammer)	91	$ 54.60
Blaster (headman)	69	69.00
Blacksmith	57	68.40
Brickmason	50	68.75
Carpenter	61	68.63
Drivers of trucks:		
1-1/2 tons or less	96	48.00
over 1-1/2 tons	91	54.60
Electrician	50	68.75
Fireman	73	54.75
Ironworker (structural)	50	68.75
Laborer (unskilled)	96	48.00
Mechanics (rep airmen)	77	69.30
Oiler	not listed	
Operators of power equipment:		
Cranes	46	69.00
Derricks	46	69.00
Dragline	46	69.00
Power shovel (steam or gas)	46	69.00
Operators of small equipment:		
Compressor (400 cu. ft. displacement or over)	73	54.75
Compressor (under 400 cu. ft. displacement)	73	54.75
Concrete mixer (5-bag or over)	55	68.75
Concrete mixer (under 5-bag)	73	54.75
Pump	73	54.75
Tractor (35 h.p. or over- bulldozer)	55	55.00
Tractor (under 35 h.p.)	73	54.75
Tractor with carry-all scraper	55	55.00
Reinforcing rod placer	not listed	

d. Delays - Damages. - Any deficiency in the supply of suitably qualified labor to be referred to the work by such agency as may be designated by the Federal Works Progress Administrator may constitute a basis for demand for the modification of this contract as provided in Article 9 as being an "Act of the Government".

e. Compensation insurance. - The contractor shall provide adequate workmen's compensation insurance for all such labor that may come within the protection of such laws and shall provide, where practicable, employers' general liability insurance for the benefit of his employees not protected by such compensation laws, and proof of such insurance satisfactory to the contracting officer shall be given.

f. Dismissal of employees. - Every employer of such persons may dismis any such employees only with the approval of the contracting officer.

g. Copies of payrolls. - The contractor shall furnish the contracting officer's representative on the work certified legible copies of payrolls, not later than the third day following the payment of wages, for all persons employed by the contractor and each subcontractor at the site of the work as follows:

(1) Two copies of payrolls for all persons assigned through the Works Progress Administration on forms prescribed by the Works Progress Administration. These forms will be supplied by the contracting officer.

(2) Two copies of payrolls for all other employees at the site of the work. These rolls may be prepared on forms regularly in use by the contractor and subcontractors.

h. Subcontractors. - The contractor shall cause appropriate provisions to be inserted in all subcontracts relating to this work for which payment is to be made from funds appropriated by the Emergency Relief Appropriation Act of 1938 to insure the fulfillment of all the provisions contained herein applicable to such funds.

1-31. Purchase of supplies and materials. - a. Preference for domestic articles. - (1) Because the materials listed below or the materials from which they are manufactured are not mined, produced, or manufactured, as the case may be, in the United States in sufficient and reasonably available commercial quantities and of a satisfactory quality, their use in the work herein specified (subject to the requirements of the specifications) is authorized without regard to the country of origin.

Platinum	Rubber	Balsa wood
Chromium	Teakwood	English ball clay
Cork	Sisal	English china clay
Jute	Silk	Natural copper nickel alloy (monel metal)
Kauri gum	Tin	
Lac	Asbestos	
Nickel	China wood oil (tung oil)	

(2) Articles, materials, or supplies, manufactured in the United States and containing mercury, antimony, tungsten, or mica of foreign origin may be used (subject to the requirements of the specifications) in the work herein specified, because such manufactured articles, materials, or supplies have been manufactured in the United States substantially all from articles, materials, or supplies mined, produced, or manufactured, as the case may be in the United States.

b. Purchasing procedure. - Two copies of all purchase orders showing firm names and addresses, and of all shipping bills or memoranda of shipments received showing car initials and numbers, when shipped by railroad, shall be furnished promptly to the contracting officer. Such orders, shipping bill or memoranda shall clearly indicate weights, and shall be so worded or marked that each item, piece or member can be definitely identified on the drawings.

1-32. Minor modifications. - The right is reserved to make such minor changes in the execution of the work to be done under these specifications as, in the judgment of the contracting officer, may be necessary or expedient to carry out the intent of the contract; provided that the unit cost to the contractor of doing the work shall not be increased thereby, and no increase in unit price over the contract rate will be paid to the contractor on account of such changes.

1-33. Protests and appeals. - The Chief of Engineers has been designated by the Secretary of War as his duly authorized representative to make final decision, and to take other action where the terms of the contract require that such decision or action shall rest with "the head of the department concerned or his duly authorized representative." If the contractor considers any work required by him to be outside the requirements of the contract, or if he considers unfair any action or ruling of the inspectors or contracting officer, he shall ask for written instruction or decision from the contracting officer immediately. Any protest based upon such instruction or decision, or claim otherwise arising under the contract, including a request for extension of time under Article 9 of the contract, shall be submitted to the contracting officer within the period specified in the contract. If the contractor is not satisfied with the ruling of the contracting officer he may, where appeal is stipulated in the contract, make written appeal to the Chief of Engineers. Such appeal, containing all the facts and circumstances upon which the contractor bases his claim for relief, shall be addressed to the Chief of Engineers, United States Army, and presented to the contracting officer for transmittal within the time provided therefor in the contract.

1-34. Electric power to be furnished by the contractor. - The contractor shall make arrangements for, shall pay for, and furnish all necessary power to carry on the work, including sufficient power for lighting and other miscellaneous uses in buildings furnished by the contractor for Government use. No separate payment will be made to the contractor for the power furnished.

1-35. Rate of wages. - a. In accordance with Article 17 of the contract, the minimum wages shown in the following schedule, as approved by the United States Department of Labor, shall be the minimum rates of wages to be paid by the contractor for work under this contract. Corresponding rates for occupations not listed below will be furnished upon application by the contractor.

Designation	Wage Rate - Hourly
Air tool operator (jackhammers)	$ 0.60
Blaster (headman)	1.00
Blacksmith	1.20
Brickmason	1.37-1/2
Carpenter	1.12-1/2
Drivers of trucks:	
one and 1/2 tons or less	.50
over 1-1/2 tons	.60
Electrician	1.37-1/2
Fireman	.75
Ironworker (structural)	1.37-1/2
Laborer (unskilled)	.50
Mechanics (repairmen)	1.00
Oiler	.75
Operators of power equipment:	
Cranes	1.50
Derricks	1.50
Draglino	1.50
Power shovel (steam or gas)	1.50
Operators of small equipment:	
Compressor (400 cu. ft. displacement or over)	.87-1/2
Compressor (under 400 cu. ft. displacement)	.75
Concrete mixer (5-bag and over)	1.25
Concrete mixer (under 5-bag)	.75
Pump	.75
Tractor (35 h.p. or over - bulldozer)	1.00
Tractor (under 35 h.p.)	.75
Tractor with carry-all scraper	1.00
Reinforcing rod placer	1.12-1/2

b. Any class of laborers and mechanics not listed above, which will be employed on the work, will be classified or reclassified by the contracting officer to conform to the foregoing schedule. In the event of disagreement between the contracting officer and the contractor as to such classification or reclassification, the question, accompanied by the recommendation of the contracting officer, will be referred to the United States Department of Labor for final determination.

c. The above list of wages shall be posted by the contractor in a conspicuous place on the work,

1-36. Reports to Department of Labor. - The contractor shall report monthly, and shall cause all subcontractors to report in like manner, within 5 days after the close of each calendar month, on forms to be furnished by the Department of Labor, the number of persons on their respective pay rolls, the aggregate amount of such pay rolls, the man-hours worked, a nd the total expenditures for materials. He shall furnish to the Department of Labor the names and addresses of all subcontractors on the work at the earliest date practicable, provided that the foregoing shall be applicable only to work at the site of the construction p roject.

1-37 Standard tests, qualities and guarantees. - a. All materials, supplies and parts and assemblies thereof, entering into the work to be done under these specifications, shall be tested as specified, or otherwise required, in conformity with the best modern approved methods for the particular type and class of work.

b. Unless waived in writing by the contracting officer, all tests and trials shall be made in the presence of a duly authorized representative of the contracting officer. When the presence of the inspector is so waived, sworn statements, in duplicate, of the tests made and the results thereof, shall be furnished to the contracting officer by the contractor.

c. Costs of all tests and trials, excepting the expense of the Government inspector and cement, concrete aggregate and cylinder tests, and tests on embankment materials, shall be borne by the contractor and shall be included in the contract price (see Paragraph 7-11).

d. All materials, parts and equipment shall be of the highest grade, free from defects and imperfections, of recent manufacture, new and unused. Workmanship shall be of the highest grade and in accordance with the best modern standard practice.

1-38. Protection of existing structures. - During construction operations, on work covered by these specifications, the contractor shall protect all existing structures and accepted work. Any disturbances or damage to any structures by operations under these specifications shall be repaired promptly by the contractor without cost to the Government.

1-39. Final acceptance and payment. - As soon as practicable after the completion of the entire work the contracting officer will make a thorough examination of same and if it is found to comply fully with the requirements of the specifications, it will be accepted, and final payment will be made in accordance with Article 16 of the contract.

1-40. Approval. - This contract will be subject to the written approval of the Division Engineer, North Atlantic Division, and shall not be binding until so approved.

SECTION II. PREPARATION OF SITE (Item 1).

2-01. Work included. - Clearing and disposal of materials shall be done as directed by the contracting officer, within the limits shown on the drawings.

2-02. Clearing. - a. The areas to be cleared shall include: (1) The area within the limits of the required excavation for the diversion canal, (2) the areas within the limits of the foundations for the walls and drop structure, including the bridge, (3) the areas within the limits of the roadway grading of the proposed highway relocations, (4) any areas contiguous to the above areas designated by the contracting officer within the limits shown on the drawings.

b. Trees and other obstructions shall be removed by the contractor from the sites of the proposed structures and of the excavation and embankment when and as directed by the contracting officer and may be removed from other areas only to the extent directed or permitted. The contractor shall preserve and protect from injury all trees not required to be removed.

c. All timber, undergrowth, brush, logs, weeds, and debris of any nature shall be cleared and removed. Within the limits of the roadway embankments trees and brush 4 inches or less in diameter shall be cut at the ground surface, and trees exceeding 4 inches in diameter shall be cut not more than one foot above the ground.

2-03. Removal of structures. - The removal of existing structures and utilities required to permit the orderly prosecution of the work covered by these specifications shall be accomplished by local agencies unless otherwise shown on the drawings, in a manner satisfactory to the contracting officer. Whenever a telephone or telegraph pole, pipe line, conduit, sewer or other utility is encountered and must be removed to permit completion of the work, the contracting officer will notify the proper local authorities, and the designated utility will be promptly removed.

2-04. Disposal of materials. - All materials removed, as specified above, shall be disposed of by burning or by removal to approved disposal areas as directed. No material shall be thrown into, or left along the bank of, the canal. The disposal of material shall closely follow the operations of clearing. At no time shall material be placed on land adjacent to the construction area. No damage of any nature shall be inflicted upon adjoining property owners by unwarranted entry or disposal of material on adjacent property.

2-05. Measurement and payment. - The quantity to be paid for under Item 1 will be the number of acres cleared. Payment for all work in connection with the preparation of the site as above specified, including the loading, hauling, and disposal of the materials, will be made at the contract unit price for Item 1, "Preparation of Site."

SECTION III. EXCAVATION (Items 2 and 3).

3-01. General provisions. - a. Scope of work. - The location, character of the proposed structures, the location and logs of borings and test pits are shown on the drawings (see Paragraph 1-04). It is the intent of the Government to excavate to the lines and grades given thereon but the right is reserved to modify any part of the work if, in the opinion of the contracting officer, conditions require such modification (see Articles 3 and 4 of the contract).

b. Disposal of material. - Material from the excavations shall be used, if possible, in the permanent construction as directed by the contracting officer. No material shall be wasted unless specifically authorized by the contracting officer. If, at the time of excavation, it is not possible to place the material in the proper section of the permanent construction, it shall be stock-piled in approved areas for later use. Materials from the excavation that are unacceptable for use in the permanent construction shall be wasted in spoil areas in approved locations as directed by the contracting officer.

c. Measurement. - Excavation will be measured in place and the volume thereof will be based on surveys made just prior to the commencement of the work of the areas to be excavated, and on the excavation lines indicated on the drawings or such modifications thereof as may be necessary to adapt them to the changes referred to in subparagraph (a) above.

d. Payment. - (1) Items included. - The contract prices for the various classes of excavation shall include the cost of all labor, plant and incidental costs, for excavating, loading, hauling and disposing of the material in the embankment or spoil areas, including any stock-piling and rehandling.

(2) Construction roads. - The cost of construction and maintenance of roads and bridges for the contractor's use will not be paid for under a separate item in the contract but shall be included in the prices bid for the other items of work.

(3) Pay lines.- Payment for all excavations will be made to the pay or slope lines shown on the drawings regardless of whether or not it is necessary to remove the material to slopes greater or less than those shown. No payment will be made for excavation outside of the limits described above; the contractor will be required to backfill any such excess excavation with approved material, or with concrete where excavated surfaces are to be in contact with concrete structures, at his own expense.

(4) Shoring. - Where approved by the contracting officer, shoring may be used in lieu of excavation to the slope or pay lines shown on the drawings. The contractor shall be responsible for

the unfinished work, and that workmen shall be safe from danger of caving or slides while making structure excavations. If shoring is necessary and the contractor does not use it, its use will be ordered by the contracting officer. Shoring shall be erected in a safe and workmanlike manner, and shall be placed in such a way as to afford ready inspection of and ample clearance for the permanent work. Shoring shall be removed upon completion of the permanent work as soon as the construction does not require its use. No payment will be made for shoring but the cost thereof shall be included in the contract price for the excavation.

(5) Temporary drains. - The contractor shall maintain the site of the work and adjacent grounds in a well drained condition. Temporary drains and ditches required shall be constructed by the contractor at his own expense.

3-02. Classification. - All materials excavated will be classified as follows:

a. Common excavation shall include the removal of all materials, except stripping, to the lines or grades shown on the drawings or established by the contracting officer.

b. Detailed classification is as follows:

(1) Stripping (Item 2) (see Paragraph 3-03).

(2) Common Excavation, General, (Item 3) (see Paragraph 3-04).

3-03. Stripping (Item 2). - a. Work included. (1) The hard surface of the existing highways, where it is within the limits of the grading for the relocation of highways, or other areas shown on the drawings, shall be stripped to a minimum depth of 6 inches, or to a depth directed by the contracting officer. The unsuitable materials to be removed shall include concrete and bituminous pavement, unsatisfactory rock and any other objectionable material.

b. Disposal of materials. - The provisions of Paragraph 3-01b shall apply.

c. Measurement and payment. - Measurement will be made in accordance with Paragraph 3-01c. Payment for all work in connection with stripping, including the loading, hauling, disposal of the materials, and all rehandling required, will be made at the contract unit price for Item 2, "Stripping" (see Paragraph 3-01d).

3-04. Common excavation - general (Item 3). - a. Work included. - The contractor shall excavate and dispose of the materials classified as common excavation above and below the ground water level to the lines and grades shown on the drawings for the respective areas, or as

otherwise directed by the contracting officer. Excavation shall be performed in accordance with a schedule of operations to be approved by the contracting officer. Common excavation includes excavation for the canal, walls, bridge and highway relocation, removal of detour roadway and any other required excavation for structures, drains and ditches not included in other items of the work. Excavations shall be made wide enough to permit proper sheeting and bracing where necessary.

b. Sheeting and pumping. - (1) The contractor shall provide all labor and materials wherever necessary to enclose the proposed work by temporary coffordams or otherwise, so as to excavate to the depth and lines shown on the drawings. Subject to the approval of the contracting officer, sheeting shall be so constructed and carried to such depth as to prevent excessive inflow of water and intrusion of sand and other materials into the area being excavated.

(2) The contractor shall provide all necessary pumps to unwater the site properly and to keep the site free of water during such time as the work is under construction.

c. Disposal of materials. - The provisions of Paragraph 3-01b shall apply. Excavated materials not used in permanent construction may be used in temporary construction if approved by the contracting officer.

d. Measurement and payment. - Measurement will be made in accordance with Paragraph 3-01c. Payment for all work in connection with common excavation, including the loading, hauling, disposal of materials, and all rehandling required, will be made at the contract unit price for Item 3, "Excavation, Common." (See Paragraph 3-01d).

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SECTION IV. PILING (Items 4 and 5)

4-01. Classification. - Piling shall be classified as follows:

a. Steel Sheet Piling (see Paragraph 4-02).
b. Timber Piling (see Paragraph 4-03).
c. Reinforced concrete piling (see Paragraph 4-04).

4-02. Steel Sheet Piling (Item 4). - a. Work included. - The contractor shall construct the steel sheet-piling cut-off at each end of the drop structure as shown on the drawings. The cut-off shall be constructed of piles of varying lengths, including specials, driven to grade, between the limits as shown on the drawings. Care shall be taken to avoid damage to existing utilities encountered in the work.

b. Type and properties. - The piles shall be of the arch web type and shall have a minimum thickness of metal of 3/8 inch, except that a reasonable reduction for shaping the joints of the interlock will be permitted. The piles shall provide a section modulus of not less than 5.4 inches cubed per linear foot of cut-off, and shall weigh not less than 22 pounds per square foot of cut-off, exclusive of any welded or riveted connection or reinforcement. The interlocked joints shall develop a strength in direct tension of not less than 8,000 pounds per linear inch of interlock without rupture. The piles shall be continuously interlocked throughout their entire length and shall be provided with standard pulling holes. The type and dimensions of the piles the contractor proposes to furnish shall be submitted to the contracting officer for approval before any piles are delivered to the work.

c. Material. - The steel for the sheet piling shall be new and shall conform to Federal Specification QQ-S-751A for "Steel: Structural (Including Steel for Cold Flanging) and Steel: Rivet (for) Ships other than Naval Vessels, "Structural Grade, except for the following requirements:

(1) Tensile Strength shall be not less than 70,000 pounds per square inch, except that fabricated sections such as corner piles, tee piles and other special sections shall be of steel having a tensile strength of not less than 60,000 pounds per square inch.

(2) Elongation in 8 inches, minimum $\frac{1,400,000}{\text{tensile strength}}$

(3) Bend Test Specimens shall withstand bending 180 degrees around a pin with a diameter twice the thickness of the specimen without fracture on the outside of the bend.

d. Driving. - The piles shall be driven to form a continuous interlocking diaphragm down to rock or to the elevation established for the bottom of the cut-off as shown on the drawings. A

protecting cap shall be used in driving. The hammers shall be of a suitable size and type, either steam or air operated. The use of a water jet may be permitted at the discretion of the contracting officer. Piles shall be driven without injury to them, true to line and grade, and shall be cut off, where necessary, to the top elevation of the sheet-piling cut-off as shown on the drawings. Proper precautions shall be taken to prevent rupture at the interlocks. Piles ruptured at the interlock or otherwise injured shall be removed and replaced by new piles at the contractor's expense. Special sections, including toes, corners and wedges, shall be installed as shown on the drawings, or if in the opinion of the contracting officer, such sections are necessary to insure proper construction of the sheet-piling cut-off.

c. Measurement and payment. - The quantity of steel sheet piling to be paid for will be the number of square feet of sheet piling actually in place as specified below the top elevation of the sheet-piling cut-off. Payment will be made at the contract unit price for Item 4, "Steel Sheet Piling", and shall include the costs of all labor, materials, equipment and incidentals required to construct the sheet-piling cut-off as specified.

4-03. Timber piling (Item 5). - a. Work included. - The contractor shall furnish all labor, material, and equipment, and do all work required for driving timber piling in structure foundations as shown on the drawings. The piles shall be driven at the locations shown on the drawings. The length of piles may be determined from the results of actual test piles.

b. Timber piles. - Timber piles shall be oak, hickory, white ash, beech, rock elm, yellow birch, sugar maple, locust, black walnut, pecan, persimmon or dense (close-grain) southern yellow pine conforming to the tentative specifications of the American Society for testing materials for "Timber Piles" serial designation D25-35T, "Class C Piles", except that the minimum tip diameter for any length pile shall be 8 inches. Other approved species of wood may be used provided the butt and tip dimensions are such that resistance to shock and bending stresses shall be equal to the above specified southern yellow pine. The piles shall be peeled entirely free from bark.

c. Driving. - The piles shall be driven (tip or small end down) with an air or steam hammer of suitable size and type to properly drive the piles without injuring them. All timber piles shall be driven to such a depth that the bearing capacity computed in accordance with Paragraph 4-03d shall be 20 tons per pile. Piles shall be driven plumb to a tolerance of 1/4 inch per foot of length and a spacing tolerance of 6 inches. If necessary to prevent splitting or brooming, metal driving caps or collars shall be provided. After being driven, the top ends of all piles shall be sawed off to the required elevation and trimmed so as to leave no horizontal projection outside the cap. If any piles are raised by the subsequent driving of others they shall

be redriven. Piles injured by driving, or those driven out of place, shall be pulled out or cut off and replaced by new piles. Piles shall be of the full length required and lengthening by means of splices or butt joints will not be permitted.

d. The safe bearing capacity for each timber pile shall be not less than 20 tons. The bearing capacity shall be determined by the following formulas:

$$P = \frac{2\,WH}{S + 0.1}$$ for single acting steam hammer

$$P = \frac{2\,E}{S + 0.1}$$ for double acting steam hammer

Where P = load in pounds, W = weight of falling hammer in pounds, H = height of fall in feet, S = average penetration in inches per blow for the last few blows (5 to 10 blows for single acting hammers and 10 to 20 blows for double acting hammers). E = energy in foot pounds per blow as listed by the manufacturer for the given number of strokes per minute.

The above formulas are applicable when:

(1) The hammer has a free fall.

(2) The head of the pile is free from broomed or crushed wood fibre.

(3) The penetration is at a reasonably quick and uniform rate.

(4) There is no appreciable bounce after the blow. Twice the height of the bounce shall be deducted from "H" to determine its true value in the formula.

The hammer shall be of such size and capacity that the indicated bearing capacity of the pile calculated by the above formulas, when S = zero, shall be not less than 50 per cent greater than the required bearing capacity of the pile.

c. Measurement and payment. - The quantity to be paid for will be the number of linear feet of timber piling satisfactorily placed below the elevation of cut-off as shown on the drawings, and shall include the cost of tests made on piles. The measurement of quantity shall be made after cut-off. Payment will be made at the contract unit price for Item 5 or Item 5A (1), as applicable.

4-04. Precast concrete piling (Item 5A.). - a. General. - As an alternate to Item 5, "Timber Piling", the contractor may submit a bid

price under Item 5A for the furnishing and placing of Timber Piling and Reinforced Concrete Piling, as indicated on the drawings. The reinforced concrete piling shall be a standard commercial product, approved by the contracting officer, square in shape with a minimum size of 16 x 16 inches, and of a proper length to produce a safe bearing capacity of 40 tons for each pile.

b. Work included. - The contractor shall furnish all labor, material, and equipment and do all work required for driving concrete piling on structure foundations as shown on the drawings. The piles shall be driven at the locations shown on the drawings. The length of piles may be determined from the results of actual test piles.

c. Materials. - (1) Concrete. - The concrete shall conform to the requirements of Section VII for Class "A" concrete.

(2) Reinforcing. - The reinforcing steel shall conform to Paragraph 7-18b.

d. Driving. - The piles shall be driven with an air or steam hammer of suitable size and type to properly drive the piles. If necessary to prevent damage to the pile heads, a suitable cushion shall be provided. Piles shall be driven plumb to a tolerance of 1/4 inch per foot of length. After being driven, the top ends of all concrete piles will be cut off to the elevations of the tops of the piles as indicated on the drawings. If any piles are raised by the subsequent driving of others, they shall be redriven. Piles injured by driving, or those driven out of place, shall be pulled out and replaced by new piles. Piles shall be of the full length required and lengthening by means of splices or butt joints will not be permitted. All concrete piles shall be driven to such a depth that the bearing capacity computed in accordance with Paragraph 4-03d shall be 40 tons per pile.

e. Measurement and payment. - The quantity to be paid for under Item 5A (2) will be the number of linear feet of concrete piling satisfactorily placed below the elevation of the cut-off as shown on the drawings, and shall include the cost of tests made on the piles. The measurement of quantity shall be made after cut-off. Payment will be made at the contract unit price for Item 5A (2), "Reinforced Concrete Piling," and shall include all costs of furnishing and installing the piling.

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SECTION V. MISCELLANEOUS FILL AND BACKFILL
(Items 6 to 9, inclusive)

5-01. Definitions. - "Screened Gravel", Item 6A, will be required for gravel bedding and filters. "Crushed Stone, Item 6B, will be required for the drains. "Compacted Backfill", Item 7, will be required behind the bridge abutments and other structures as shown on the drawings or as directed by the contracting officer.

5-02. Screened gravel (Item 6A). - a. Work included. - The contractor shall place screened gravel of the specified quality for gravel bedding for riprap, derrick stone, and filters at the locations shown on the drawings or as directed by the contracting officer.

b. Materials. - Screened gravel shall consist of suitable coarse clean gravel satisfactorily graded within the specified limits, and unless otherwise directed, not more than ten per cent by weight shall pass a standard sieve having 10 meshes to the inch, and all shall pass a 2-inch square mesh screen.

c. Placing. - The material shall be placed as shown on the drawings or as directed, with such hand-placing as may be necessary to trim to the required slopes. The contractor will not be required to tamp or roll the material, but shall consolidate it with water to the extent directed.

d. Measurement and payment. - The quantity to be paid for under Item 6A will be the number of cubic yards furnished and placed to the limits shown on the drawings, or ordered. Payment will be made at the contract unit price for Item 6A, "Screened Gravel."

5-03. Crushed stone (Item 6B). - a. Work included. - The contractor shall place crushed stone of the specified quality for drains, at the locations shown on the drawings or as directed by the contracting officer.

b. Materials. - The crushed stone backfilling used for the drains shall consist of angular fragments of uniform quality throughout, of 4-inch maximum size, free from thin or elongated pieces, soft or disintegrated stone, dirt or other objectionable matter. It shall be graded so that not more than 50 per cent by weight of stone will be retained on a standard No. 2 mesh sieve with openings of 1-1/4 inches and not more than 15 per cent by weight shall pass a 3/4-inch mesh sieve.

c. Placing. - The material shall be placed as shown on the drawings or as directed, with such hand-placing as may be necessary to trim to the required slopes.

d. Measurement and payment. - The quantity to be paid for

under Item 6B will be the number of cubic yards furnished and placed to the limits shown on the drawings or as directed by the contracting officer. Payment will be made at the contract unit price for Item 6B, "Crushed Stone."

5-04. Compacted backfill (Item 7). - a. Work included. - The contractor shall place, grade, and consolidate materials required for backfill of the bridge abutments, and elsewhere as directed.

b. Borrow. - Materials shall be obtained from stock-piles of excavated materials (see Paragraph 3-01b), or may be obtained directly from required excavations. Backfill material shall be free from stumps, roots, sod, rubbish, or other unsuitable materials or substances.

c. Placing. - The backfills shall consist of materials suitable for the purpose as determined by the contracting officer, and shall be placed in successive layers of not more than 12 inches in depth for the full width of the cross section. Each layer shall be compacted thoroughly with a crawler type tractor weighing not less than 20,000 pounds, or as provided in Paragraph 5-06c. A minimum of four passes of the tractor treads on each square foot of backfill area will be required for satisfactory compaction. Portions of the backfill area which the compacting equipment cannot reach for any reason shall be thoroughly compacted by tamping with hand or power tampers in 2-inch layers. The compaction for such portions of the backfill shall be equivalent to that obtained by compacting with tractor equipment.

d. Measurement and payment. - Measurement will be made by the cubic yard for the amount of compacted backfill placed in the completed work to the lines and grades shown on the drawings or as directed by the contracting officer. Quantities will be measured in place after any settlement. Payment for all work in connection with furnishing and placing compacted backfill will be made at the contract unit price for Item 7, "Compacted Backfill".

5-05. Semi-compacted backfill (Item 8). - a. Work included. - The contractor shall place, grade and consolidate materials required for semi-compacted backfill behind canal walls, over pipe drains and culverts, and at other locations as directed by the contracting officer. The material shall be placed in 12-inch horizontal layers with only such hand placing as may be necessary to trim to the required slopes. The contractor will not be required to roll the material, but will be required to consolidate it with water to the extent required so that no settlement or voids will later result. Hand tamping shall be done where required by the contracting officer.

b. Materials. - Materials shall be obtained from stock-piles of excavated materials (see Paragraph 3-01b), or may be obtained directly from required excavations. Backfill material shall be free from stumps, roots, sod, rubbish or other unsuitable materials or substances.

c. Measurement and payment. - Measurement will be made by the cubic yard for the amount of semi-compacted backfill placed in the completed work to the lines and grades shown on the drawings or as directed by the contracting officer. Quantities will be measured in place after any settlement. Payment for all work in connection with placing semi-compacted backfill will be made at the contract unit price for Item 8, "Semi-compacted Backfill". (See Paragraph 5-04d).

5-06. Highway embankment (Item 9). - a. Work included. - Highway embankment includes the compacted fill required in highway relocation and construction of Detour Route 10 except compacted backfill as provided for in Paragraph 5-04. The contractor shall place, grade and consolidate materials required for highway embankment.

b. Materials. - Materials shall be obtained from stock-piles of excavated materials (see Paragraph 3-01b), or may be obtained directly from required excavations. Embankment materials shall be free from stumps, roots, sod, rubbish or other unsuitable materials.

c. Placing. - The embankment shall consist of the materials suitable for the purpose in the opinion of the contracting officer, and shall be placed in successive layers of not more than 12 inches in depth for the full width of the cross section. Each layer shall be compacted thoroughly with a three wheel power roller weighing 20,000 pounds or tamping rollers so designed that the load on each tamper foot will be not less than 50 pounds per square inch of cross-sectional area. Rollers shall move longitudinally parallel to the center line overlapping on successive trips. Outer edges of embankment shall receive the same compaction as middle of fill. Portions of the embankment which the compacting equipment cannot reach for any reason shall be compacted thoroughly by tamping with hand or power tampers in 2-inch layers. The compaction for such portions of the embankment shall be equivalent to that obtained by compacting equipment.

d. Measurement and payment. - Measurement will be made by the cubic yard for the amount of compacted embankment placed in the completed work to the lines and grades as shown on the drawings or as directed by the contracting officer. Quantities will be measured in place after any settlement. Payment for all work in connection with furnishing and placing highway embankment will be made at the contract unit price for Item 9, "Highway Embankment" (see Paragraph 5-04d).

SECTION VI. RIPRAP AND DRAINS (Items 10 to 12 incl.)

6-01. Definitions. - Drains shall include "Tile Pipe," required for the drainage system under the drop structure and "Corrugated Metal Pipe," will be required for culverts at the designated location. "Riprap, Derrick Stone" will be required at the toe of the drop structure and "Riprap - Hand Placed" will be required at the entrance to the drop structure.

6-02. Tile pipe (Item 10). - a. Work included. - The contractor shall furnish and lay tile pipes of the required diameters, including specials, for the drainage system under the drop structure as shown on the plans or directed by the contracting officer.

b. Materials. - All pipe shall be bell-and-spigot, vitrified, clay pipe conforming to the requirements of Federal Specifications SS-P-361, or subsequent revisions thereof. Each pipe shall be carefully inspected immediately before laying and no cracked, broken or otherwise imperfect pipe shall be used, except for minor defects which in the opinion of the contracting officer does not impair the fitness of the pipe for the purpose intended.

c. Excavation. - Excavation shall be accomplished as shown on the drawings and as provided in Paragraph 3-04. All rock or boulders shall be removed to a depth of 6 inches below the grade of the bottom of the trench and voids backfilled with suitable material well compacted. Trenches for the drainage system under the drop structure shall be excavated to the dimensions shown on the drawings.

d. Laying pipe. - All pipe shall be placed in the trench immediately after the excavation is completed, and the gravel bedding and gravel filter are placed as shown on the drawings. Proper care shall be used in handling the pipe to avoid injury or breakage. The pipe shall be carefully bedded, and properly connected and jointed. Bell holes shall be excavated to insure that each pipe shall rest firmly upon its bed for the entire pipe length. The pipes shall be laid with open joints true to the lines and grades shown on the drawings or as staked in the field, with bells upgrade and with spigot ends fully entered in the bells. A strip of burlap at least 6 inches in width and overlapping at least 6 inches shall be carefully and securely wrapped around the pipe joints.

e. Backfilling. - Backfill material as shown on the drawings shall be evenly spread and compacted around and over the pipe to the limits shown on the drawings or as directed by the contracting officer (see Paragraphs 5-03 and 5-04). The backfilled trench shall be covered with a layer of roofing weighing not less than 35 pounds per square for the entire length of the trench as shown on the drawings, to prevent filtering of concrete into the drain.

f. Measurement and payment. - (1) Measurement for payment will be based on the linear feet of pipe of the size installed. Payment for pipe will be made at the contract unit price for Item 10, "Tile Pipe" for the size installed, and shall include all costs of furnishing and installing the pipe, except the cost of excavation and backfilling.

6-03. Corrugated metal pipe (Item 11). - a. Work included. - The contractor shall furnish and lay corrugated metal pipe required for culverts, as shown on the drawings or as directed by the contracting officer.

b. Materials. - (1) All pipe shall be of galvanized 12-gage metal and shall meet the requirements of Federal Specification QQ-C-806, as amended March 1936, and in addition shall be completely coated inside and out with an asphalt cement, which will meet the performance requirements set forth herein.

(2) The asphalt cement shall be 99.5 per cent soluble in carbon bisulphide.

(3) Thickness of coating. - The entire outside of the pipe and the inside of the pipe for three-fourths of the circumference (top of pipe when installed) shall be uniformly coated to a minimum thickness of .05 inches. The thickness shall be measured on the crests of the corrugations. The interior bottom quarter of the circumference shall be of such thickness as to comply with the Erosion Test herein described.

(4) Stability test. - The asphalt cement shall not lose its stability when subjected to the highest summer temperature as indicated by successfully withstanding the following test:

Parallel lines shall be drawn along the valleys of the Corrugations of a representative sample of coated pipe and the specimen placed on end in a constant temperature oven, with the parallel lines in a horizontal position. The temperature of the specimen shall be maintained within 2° F. of 150° F. for a period of four hours. At the end of this time no part of any line shall have dropped more than one-fourth inch.

(5) Cold test. - The coating shall adhere to the metal tenaciously and shall not chip off in handling, as indicated by successfully withstanding the following test:

A steel ball 2-1/4 inches in diameter and weighing 1.67 pounds shall be dropped from a height of 7-1/2 feet through a vertical tube of 2-1/2 inch inside diameter, upon the outside crest of a coated corrugation of a full round, riveted section of culvert pipe. This test shall be conducted with the specimen at a temperature of 32° F. Failure of the coating on the inside of the culvert pipe, as indicated by spalling from the metal or the formation of cracks longer than 1/2 inch from the point of impact, shall be considered sufficient cause for rejection.

(6) Impervious test. - The asphalt cement shall be impervious to liquids as indicated by the following test:

A 25 per cent solution of sulphuric acid, or a 25 per cent solution of sodium hydroxide, or a saturated salt solution (such as sodium chloride) shall be held in the valley of a corrugation for a period of 48 hours, during which time no loosening or separation of the bituminous material from the galvanizing shall have taken place.

(7) Erosion test. - A representative sample consisting of a two-foot length of a fully coated pipe (with ends closed by suitable bulkheads) shall be revolved end over end about its transverse axis at a speed of 3.7 revolutions per minute and in such a manner that the erosive charge shall alternately roll along the inner surface of opposite sides of the pipe (inside top and bottom, as when installed in service). At least 75 per cent of the sample shall be immersed, as it revolves, in a bath of water maintained at a temperature of 50° - 55° F. The top three-quarters of the pipe, shall not show areas of bare metal more than two inches in length on four of the seven central corrugations after five hours of continuous testing (called a test period) and the bottom one-quarter shall not show a similar failure in nine additional periods of testing. A new erosive charge shall be used for each period of test. The erosive charge shall be 50 pounds of Grade "B" building brick, conforming to the requirements of the A.S.T.M. Serial Designation C62-30, broken up into pieces two to three inches in diameter, and three gallons of water.

c. Excavation. - Excavation shall be done as shown on the drawings and as provided for in Paragraph 3-04. Pipe trenches shall have a width at least 12 inches greater than the outside diameter of the pipe. The bottom of the trench throughout its length shall be carefully formed to fit the circular shape of the pipe, so that the pipe shall be firmly supported on the bottom and for at least one third of its diameter up each side. All rock or boulders shall be removed to a depth of 6 inches below the bottom grade of the trench and the voids backfilled with well compacted suitable material.

d. Laying pipe. - All pipe shall be placed in the trench immediately after the excavation is completed. Proper care shall be used in handling the pipe to avoid injury. The pipe shall be carefully bedded, and properly connected and jointed. The pipes shall be laid true to the lines and grades shown on the drawings or as staked in the field. The interior of the pipe shall be carefully cleaned after laying to remove dirt and other obstructions.

e. Backfilling. - Backfill material shall be evenly spread and compacted under and around the pipe. Backfill over the pipe shall be done in accordance with the provisions of Paragraph 5-04 unless otherwise shown on the drawings or directed by the contracting officer.

f. Measurement and payment. - Measurement for payment will be based on the linear feet of pipe of the size installed. Payment for pipe shall include all costs of furnishing and installing the pipe except the cost of excavation, backfilling, and any concrete required. Payment will be made at the applicable contract unit prices for Item 11a and 11b "Corrugated Metal Pipe".

6-04. Riprap - derrick stone (Item 12a). - a. Work included. - (1) The contractor shall furnish and place derrick stone riprap at the toe of the drop structure as shown on the drawings or directed by the contracting officer.

(2) The contractor shall do all preliminary grading and any other incidental work, not included in any other item, required to prepare the site for derrick stone riprap.

b. Material. - Derrick stone shall be composed of hard, durable stone having a specific gravity of not less than 2.65. It shall be angular and roughly uniform in shape. The size of any individual stone shall be not less than one-half cubic yard in volume and at least 50 per cent of the stones shall be at least one cubic yard in size and no stones shall be greater than two cubic yards in size.

c. Placing. - Derrick stone riprap shall be placed on a gravel blanket (see Paragraph 5-02). It shall be constructed to the thickness and to the extent as shown on the drawings. The average surface of the derrick stone riprap shall approximate the required theoretical. The contractor will be required to place each stone by derrick and to rearrange stones which cause unsatisfactory depressions below grade or project unsatisfactorily above grade. A tolerance of 6 inches above or below the grade line as shown on the drawings or staked in the field, will be permitted for the finished surface of the riprap.

d. Measurement and payment. - The quantity to be paid for under Item 12a will be the number of cubic yards of derrick stone riprap satisfactorily placed to the specified lines or grades in the completed work. Payment will be made at the contract unit price for Item 12a, "Riprap - derrick stone." The contract unit price shall include payment for all materials, equipment, labor and incidentals required to construct and trim the riprap.

6-05. Riprap - hand placed (Item 12b). - a. Work included. - Riprap shall be placed, to the lines and grades shown on the drawings, on the canal floor and slopes at the entrance of the drop structure, and elsewhere as required by the contracting officer.

b. Material and placing. - Riprap shall be of durable rock of acceptable sizes with a specific gravity of not less than 2.65. Suitable rock from borrow pits and quarries shall be used. The riprap shall be laid to the lines and grades shown on the drawings or as

directed. A tolerance of 3 inches above or below the slope line shown on the drawings will be allowed from the finished slope surface of the hand-placed riprap. Rock for riprap shall be angular and of uniform shape so as to furnish an even, reasonably smooth surface. Not more than 5 per cent by weight of the rock shall be smaller than one-half cubic foot in volume and at least 75 per cent of the rock used shall be from 1 to 2 cubic feet in volume with one dimension approximately equal to the depth of the riprap course. The rock shall be closely laid on a base of selected screened gravel (see Paragraph 5-02), with the proper dimension normal to the slope approximately equal to the depth of the riprap, and with joints broken where possible. The joints on the surface of the riprap shall be filled with tightly driven spalls. Large rock shall be well bedded at the edges of the riprap to prevent undermining.

c. Measurement and payment. - The quantity to be paid for under Item 12b will be the number of cubic yards of riprap satisfactorily placed in the completed work to the specified or ordered lines and grades. Payment will be made at the contract unit price for Item 12b "Riprap - Hand Placed," and shall include all costs for furnishing, hauling and placing the riprap.

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SECTION VII. CONCRETE (Items 13 to 17)

COMPOSITION, CLASSIFICATION AND STRENGTH

7-01. Composition. - Concrete shall be composed of cement, fine aggregate, coarse aggregate, and water so proportioned and mixed as to produce a plastic, workable mixture in accordance with all requirements under this section and suitable to the specific conditions of placement.

7-02. Classification. - Except where required to meet special conditions all concrete shall be either Class "A" or Class "B", as designated in Section VIII and on the drawings for the various parts of the work in accordance with the conditions of application and the proportions of materials and strengths required.

7-03. Strength. - The mixes will be designed to secure concrete having at least the following compressive strengths at the age of 28 days, as determined by breaking standard 6-inch diameter by 12-inch height or 8-inch diameter by 16-inch height test specimens:

Class	Average for any 25 consecutive cylinders	Minimum for any one cylinder
A	3400 lbs. per sq. in.	2600 lbs. per sq. in.
B	3000 lbs. per sq. in.	2200 lbs. per sq. in.

7-04. High-early-strength-concrete. - High-early-strength concrete made with high-early-strength Portland cement or other special cements shall be used only when specifically authorized by the contracting officer. The 7-day compressive strength of concrete of any class, when made with high-early-strength cement, shall be at least equal to the specified minimum 28-day compressive strength for that class. All provisions of these specifications, except for cement, shall be applicable to such concrete. Any high-early-strength cement used shall be approved by the contracting officer before use.

MATERIALS

7-05. Portland cement (Item 13). - a. The contractor shall furnish Portland cement of the quality herein specified in sufficient quantity for the work required. Cement for all concrete, grout and mortar, except as specified in Paragraph b, shall conform to Federal Specification SS-C-206, for "Cement, Portland, Moderate-Heat-of-Hardening, September 30, 1936", except that Paragraph E-7, Heat of Hydration, shall be considered inoperative.

b. High-early-strength Portland cement. - Cement for high-early-strength concrete shall be in accordance with Federal Specification SS-C-201, for "Cement, Portland, High-Early Strength."

c. Special test requirements. - Cement will be tested by the Central Concrete Laboratory, West Point, New York. No cement shall be used until notice has been given by the contracting officer that the test results are satisfactory. Cement which has been stored, other than in bins at the mills, for more than 4 months after being tested shall be retested before use. Ordinarily, no cement shall be used until after it has satisfactorily passed both the 7 and 28-day tests, but in cases of emergency the contracting officer may waive the 28-day tests and permit the use of cement which has satisfactorily passed the soundness and 7-day tests; provided it is the product of a quarry and mill having established a reputation of not less than 3 years' standing, for the production of high-grade cement. If the tests prove any cement unsatisfactory which have been delivered at the site of the work, such cement shall be promptly removed from the work and its vicinity.

d. Identification. - Cement shipped in bags shall be identified by marking or tagging the bags with the identifying number or symbol of the Federal Specifications under which it was manufactured. Bulk shipments of cement shall be likewise identified by a suitable device affixed to each car or other type of bulk carrier. Marking or tagging shall be done at the mill.

e. Quality and packages. - All cement shall be dry, finely ground and free from lumps or caking. Unless otherwise permitted, the cement shall be delivered in canvas bags or other strong, well-made packages, each plainly marked with the manufacturer's brand. The weights of such bags shall be uniform. Packages received in broken or damaged condition will be rejected or accepted only as fractional packages. Cement shall be stored in a satisfactory manner so as to be unaffected by moisture, keeping each carload separate until the results of the 28-day tests are known. Suitable accurate scales shall be provided by the contractor for weighing the cement.

f. Records of cement used. - The contractor shall furnish to the contracting officer, at the end of each day's work, a statement showing in such detail as he may reasonably require the quantity of cement used during the day at each part of the work.

7-06. Fine aggregate. - a. Compaction. - Fine aggregate shall be natural sand.

b. Quality. - Fine aggregate shall consist of hard, strong, durable and uncoated particles.

c. Grading. - (1) Except as provided in (2) below fine aggregate shall conform to the following requirements:

Total passing	Per cent by weight
No. 4 sieve	95 - 100
No. 16 sieve	45 - 75
No. 50 sieve	10 - 25
No. 100 sieve	1.5 - 7

(2) Deficiencies in the percentages of fine aggregates passing #50 and #100 sieves, as required in the above gradation, may be remedied by the addition of pozzuolanic or cementitious materials, excepting Portland cement; provided, at least 5 per cent passes the #50 sieve and the aggregate is of proper consistent gradation within the specified limits. Such added material, which will be considered and included as fine aggregates, shall conform to the requirements in Paragraph 7-08, and shall be in sufficient quantity to meet the minimum requirements above for percentage passing #100 sieve and otherwise to product the workability required by the contracting officer. The quantity and characteristics of any material used for the purpose of correcting workability shall be such that when the concrete is gaged to the proper consistency the total water content shall not exceed by more than 1 gallon per cubic yard the minimum quantity required for proper consistency when not using the admixture. The blending of any material with the original naturally graded sand to remedy deficiency in gradation shall be accomplished in charging the mixture, unless otherwise specifically authorized by the contracting officer.

d. Deleterious substances. - The substances designated shall not be present in excess of the following amounts:

	Per cent by weight
Clay lumps	1
Material removed by decantation from aggregates not more than	3
Shale	0.5

e. Mortar strength. - Mortar specimens made with the fine aggregate shall have a compressive strength at 28 days of at least 90 per cent of the strength of similar specimens made with Ottawa sand having a fineness modulus of 2.40 + 0.10 and the same cement.

f. Tests. - Fine aggregate shall be subject to careful, thorough analyses, including magnesium sulphate soundness tests (see Paragraph 7-07d), to determine conformity with all requirements of these specifications.

7-07. Coarse aggregate. - a. Composition. - Coarse aggregate shall be washed gravel or crushed stone.

b. Quality. - Coarse aggregate shall consist of hard, tough and durable particles free from adherent coating. It shall contain no vegetable matter nor soft, friable, thin or elongated particles in quantities considered deleterious by the contracting officer. The substances designated shall not be present in excess of the following amounts (by weight):

Soft fragments	5%
Clay lumps	1/4%
Removed by decantation	1%

When the material removed by decantation consists essentially of crusher dirt the maximum amount permitted may be raised to 1-1/2 per cent. Aggregate which has disintegrated or weathered badly under exposure conditions similar to those which will be encountered by the work under consideration, shall not be used. When crushed stone is used the crusher shall be equipped with a screening system which will entirely separate the dust from the stone and convey it to a separate bin.

c. Size. - (1) Coarse aggregate shall be well graded from fine to coarse so that concrete of the required workability, density, and strength can be made without the use of an excess amount of sand, water, or cement.

For Class "A" concrete, required for Items 15 and 16, the maximum size mesh screen for the aggregate shall be one inch.

For Class "B" concrete, the maximum size mesh screen for the aggregate shall be not less than 1 inch nor more than 2 inches, unless otherwise specified.

(2) When the maximum size mesh screen is greater than 1 inch, the aggregate shall be separated, and the specified sizes delivered separately to individual proportioning hoppers, in accordance with the following:

For Maximum Size Mesh Screen, 1 in. to 2 in. inclusive:

(1) No. 4 to 1/2 maximum size mesh screen, inclusive.
(2) Over 1/2 maximum size to and including full maximum size mesh screen.

Within any of the above-indicated size-limits, not less than 85 per cent of the material shall be retained on a standard square mesh screen of the minimum size indicated and not more than 5 per cent shall be retained on a standard square mesh screen of the maximum size indicated.

(3) The grading of the coarse aggregate, in the mixed concrete, shall fall within the following limits:

	(Per cent by weight) Passing
Maximum size mesh screen (square mesh)	97 - 100
1/2 maximum size mesh screen (square mesh)	40 - 70
No. 4 sieve	0 - 6

d. Tests. - Coarse aggregate will be subjected to freezing and thawing tests and to careful, thorough analyses to determine conformity with all requirements of these specifications. Coarse aggregate will be subjected to 10 cycles of the magnesium sulphate test for soundness. No aggregate shall be used which develops a loss in excess of 10 per cent by weight.

7-08. Material added for workability. - a. The use of any material added to the mix to improve workability (see Paragraph 7-06c(2)), which, in the opinion of the contracting officer, may have an injurious effect on the strength, density, and durability of the concrete, will not be permitted. Before approval of any material, the contractor will be required to submit the results of complete chemical and sieve analyses made by an acceptable testing laboratory. Subsequent tests will be made of samples taken by the contracting officer from the supply of the material being used on the work to determine whether it is uniform in quality with that approved.

b. The material added shall be pozzuolanic, cementitious or silicious. It shall not contain effective early-heat-producing elements nor compounds, such as those contained in Portland cement, nor shall its use result in a material increase in the free-lime content of the concrete. It shall also be in conformity with the following requirements:

Free moisture - a total of not more than 3 per cent by weight.
Passing #30 sieve - not less than 100 per cent by weight.
Passing #200 sieve - not less than 85 per cent by weight.

7-09. Water. - The water used in mixing concrete shall be fresh, clean and free from injurious amounts of oil, acid, alkali, or organic matter.

7-10. Storage. - a. Cement. - Immediately upon receipt, at the site of the work, cement shall be stored in a thoroughly dry, weathertight, and properly ventilated building with adequate provisions for the prevention of the absorption of moisture. The building shall be of adequate capacity to provide for the requirements of delivery and construction schedules. Storage shall be such as to permit easy access for inspection and definite identification of each shipment.

b. Aggregates. - The fine and coarse aggregates shall be stored separately (see Paragraph 7-07c(2)) and in such manner as to avoid the inclusion of any foreign material in the concrete. Stock-piles of coarse aggregates shall be built in horizontal layers to avoid segregation.

7-11. Sampling and testing aggregates. - Except where provided otherwise by these specifications, all sampling and testing of aggregates shall be made in accordance with the Federal Specifications. Unless specified otherwise, all test samples shall be taken under the supervision of the contracting officer and supplied to the Central Concrete Laboratory, West Point, New York, by the contractor at his expense. The source from which concrete aggregates are to be obtained shall be selected by the contractor well in advance of the time when they will be required in the work, and suitable samples as they are to be used in the concrete shall be furnished to the contracting officer at least 30 days in advance of the time when the placing of the concrete is expected to begin. The contractor shall obtain fine and coarse aggregates for concrete from approved commercial sources.

PROPORTIONING, MIXING, AND PLACING.

7-12. Proportioning. - a. Basis. - All concrete materials will be proportioned so as to produce a workable mixture in which the water content will not exceed the maximum specified.

b. Control. - The exact proportions of all materials entering into the concrete shall be as directed by the contracting officer. The contractor shall provide all equipment necessary to positively determine and control the actual amounts of all materials entering into the concrete. The proportions will be changed whenever, in the opinion of the contracting officer, such change becomes necessary to obtain the specified strength and the desired density, uniformity and workability, and the contractor will not be compensated because of such changes.

c. Measurement. - All materials shall be measured by weight except that water may be measured by volume when so authorized by the contracting officer. One bag of cement will be considered as 94 pounds in weight and 1 gallon of water as 8.33 pounds.

d. Cement content. - Each cubic yard of concrete shall contain not less than the quantity of cement stated below:

Class "A" - 5.5 bags or 517 pounds.
Class "B" - 4.5 bags or 423 pounds.

For concrete deposited in water the minimum cement content shall be 6.5 bags or 611 pounds to each cubic yard of concrete in place.

e. Water content. - (1) In calculating the total water

content in any mix the amount of moisture carried on the surface of the aggregate particles shall be included. The total water content for a bag of cement for each batch of concrete shall not exceed the following:

Class "A" - 5.5 gallons or 45.8 pounds.
Class "B" - 6.5 gallons or 54.1 pounds.

In all cases, however, the amount of water to be used shall be the minimum amount necessary to produce a plastic mixture of the strength specified and of the desired density, uniformity and workability. In general, the consistency of any mix shall be that required for the specific placing conditions and methods of placement, and ordinarily the slump shall be between 1 inch and 3 inches when tested in accordance with the current specifications for "Method of Test for Consistency of Portland Cement Concrete" of the American Society for Testing Materials.

(2) An increase in the maximum water content, based only on the requirements of materials added in accordance with Paragraph 7-08b to improve workability will not be permitted unless comparative tests under job conditions show conclusively that such increase in water content will not result in a decrease in concrete strength and provided further that such increase does not exceed 1 gallon per cubic yard.

f. Aggregate content. - The total volume of aggregates to be used in each cubic yard of concrete shall be that necessary to produce a dense mixture of the required workability as determined by the contracting officer.

7-13. Mixing and placing. - a. Equipment. - Concrete shall be mixed in approved mechanical mixers of a rotating drum type, except that if permitted relatively small quantities may be mixed by hand in a satisfactory manner. Concrete shall be mixed at all times by competent and experienced men. The contractor shall provide at the site of the work a modern and dependable batch type mixing plant with a minimum capacity of 100 cubic yards of concrete per 8 hours. The plant shall include not fewer than two complete mixers with separate power plants, having a minimum capacity of 1/2 cubic yards each. The equipment shall provide adequate facilities for the accurate measurement and control of each of the materials entering the concrete. The complete plant assembly, including provisions to facilitate the inspection of all operations at all times and the adequacy and dependability of each of its parts shall be subject to the approval of the contracting officer and shall conform to the following requirements:

(1) It shall be capable of ready adjustment for compensating for the varying moisture content of the aggregates and for changing the proportionate batch weights.

(2) It shall be capable of controlling the delivery of all material within 1 per cent by weight of the specified amounts.

(3) It shall be arranged to permit the convenient removal of the material in excess of the specified tolerances.

(4) It shall include a visible dial or any suitable device which will accurately register the scale load at any stage of the weighing operations from zero to full capacity.

(5) The accuracy of the weighing equipment shall conform to the requirements of the United States Bureau of Standards and shall be tested monthly or otherwise when required at the expense of the contractor.

(6) It shall include a device for accurately measuring and indicating the quantity of water entering the concrete, and the operating mechanisms must be such that no leakage will occur when the valves are closed.

(7) It shall include a device for accurately and automatically measuring and indicating the time required for mixing, which may be interlocked to prevent the discharge of concrete from the mixer before the end of the mixing period.

(8) It shall include a device for properly recording and indicating the number of batches handled.

b. Time. - The minimum time for mixing each batch, after all materials are in the mixer, shall be as follows:

1/2 to 1-1/2 cu. yd. mixer - 1-1/2 minutes
Larger than 1-1/2 cu. yd. mixer - 2 minutes

The mixer shall revolve a minimum of 12 revolutions after all materials have been placed in it, and at a uniform speed. Neither speed nor volume capacity of the mixer shall exceed those recommended by the manufacturer. Excessive overmixing, requiring additions of water to preserve the required consistency, will not be permitted.

c. Conveying. - Concrete shall be conveyed from mixer to forms as rapidly as practicable, by methods which will prevent segregation or loss of ingredients. It shall be deposited as nearly as practicable in its final position. Conveying of concrete by means of chutes will not be permitted except for short chutes in the forms to distribute the concrete. Chutes used shall be such that the concrete slides in them and does not flow. Chutes with a flatter slope than 1 on 2 will not be permitted. There shall be no free vertical drop greater than 5 feet except where specifically authorized by the contracting officer.

d. Placing. - (1) Concrete shall be placed before initial set has occurred, and in no event after it has contained its water content for more than 45 minutes.

(2) Unless otherwise specified, all concrete shall be placed in the dry upon clean, damp surfaces, free from ice, frost or running water, and never upon soft mud, dry porous earth, or upon fills that have not been subjected to approved rolling, puddling or tamping so that ultimate settlement has occurred.

(3) Rock surfaces upon which concrete is placed shall be approximately horizontal or stepped, rough, and free from loose material or other matter interfering with a satisfactory bond. The rock shall be washed, scrubbed with steel brushes or brooms, and spread with a layer of mortar about 1/2 inch thick, immediately before the concrete is placed. The mortar shall be of the same cement-sand ratio as used in the concrete.

(4) Unless otherwise specifically authorized or directed, concrete in mass structures shall be placed in monoliths not exceeding 40 feet in length or width. The layout of all monoliths shall be as directed or approved by the contracting officer before concreting is commenced.

(5) All concrete shall be deposited in approximately horizontal layers not to exceed 24 inches in thickness unless otherwise specifically authorized or directed by the contracting officer and the concreting shall be carried on as a continuous operation, as far as practicable, until the placing in the course, section, panel or monolith is completed. Unless otherwise shown on the drawings, courses shall generally have a minimum thickness of 4 feet, and a maximum of 18 feet, except that in hot weather the contracting officer may direct the maximum be reduced to 8 feet. A minimum time interval of 48 hours shall be allowed between successive courses for the dissipation of heat or hydration.

(6) Concrete shall be placed with the aid of mechanical vibrating equipment as approved by the contracting officer. Vibration shall be transmitted directly to the concrete, and in no case shall it be transmitted through the forms. The frequency of vibration shall be not less than 5000 per minute. The intensity of vibration shall be sufficient to cause flow or settlement of the concrete into place. The vibration shall be of sufficient duration to accomplish thorough compaction as approved by the contracting officer. Vibration shall be supplemented by forking or spading by hand adjacent to the forms on exposed faces in order to secure smooth, dense, even surfaces. The concrete shall be compacted and worked in an approved manner into all corners and angles of the forms and around reinforcement and embedded fixtures.

(7) In dropping concrete through reinforcement, care shall be taken that no segregation of the coarse aggregate occurs. On flat surfaces, where the congestion of steel near the forms makes placing difficult, a mortar of the same cement-sand ratio as is used in the concrete shall be first deposited to cover the forms.

(8) All top surfaces not covered by forms and which are not to be covered by additional concrete or backfill shall be carried slightly above grade and struck off by board screed (see Paragraph 7-15).

e. Construction joints. - Vertical joints shall be formed with tongue-and-groove bonds or keys at such locations and of such shapes and dimensions as approved or directed by the contracting officer. Horizontal joints shall be formed with keys, or, where horizontal pressure is always in one direction, with steps. Where required, dowel rods shall be used. All concrete in vertical members shall have been in place not less than 12 hours, and longer if so directed by the contracting officer, before concrete in horizontal members resting thereon is placed. As soon as practicable after placing and immediately before placing the succeeding layers is resumed, all approximately horizontal surfaces shall be washed with a high pressure air-and-water jet or cleaned as otherwise directed by the contracting officer. Sand shall be added to the air-and-water jet when required, to remove alkali, algae, stains, and other substances injurious to the bond. The time and method of using the jet shall be such that all laitance, scum, etc. will be removed so that partly embedded aggregate is not disturbed and is washed clean. After final cleaning and immediately before placing is resumed, the surfaces shall be wetted and spread with a layer of mortar 1/2 inch thick, thoroughly brushed in. The mortar shall be the same cement-sand ratio as the concrete. Where specified or otherwise required by the contracting officer for watertight construction, copper strips not less than 18 inches in width and weighing not less than 20 ounces per square foot, properly crimped or bent, shall be placed in the concrete to span the joints.

f. Cold weather. - Concrete shall not be placed when the ambient atmospheric temperature is below 35 degrees F., nor when the concrete is likely to be subject to freezing temperatures before final set has occurred, unless specifically authorized by the contracting officer in writing. When so authorized, the materials shall be heated in order that the temperature of the concrete, when deposited, shall be not less than 50 degrees F. nor more than 70 degrees F. All methods and equipment for heating shall be subject to the approval of the contracting officer.

g. Hot weather. - For concrete placed during the extremely warm summer months and otherwise, when directed by the contracting officer, the aggregates shall be cooled by frequent spraying in such manner as to utilize the cooling effect of evaporation. During such periods the placement schedule shall be arranged as approved by the contracting officer in such manner as to provide time for the temperature of the previously placed course to begin to recede. The mixing water shall be the coolest available at the site in so far as is practicable.

7-14. Test specimens. - a. Number. - Test specimens, to determine

whether the compressive strength of the concrete is in accordance with that specified in Paragraph 7-03, will be taken by the inspector. At least 1 set of 3 specimens will be made for every major pour and in general for every 100 cubic yards of concrete placed, but in any event, a sufficient number of specimens will be taken to give a comprehensive knowledge of the concrete in each section of the work.

b. Method. - All specimens will be taken from the concrete at the mixing plant. The specimens will be tested by the Government at the Central Concrete Laboratory, West Point, New York. All costs of transportation and testing of specimens will be borne by the Government.

7-15. Finishing. a. Immediately after placement, the concrete shall be properly forked back along the faces of all forms by the use of standard concrete forks or spades unless otherwise specifically authorized or directed by the contracting officer. The finished surfaces shall be free from sand streaks or other voids and the plastering over of such surfaces will not be permitted. Defective concrete shall be repaired by cutting out the unsatisfactory material, to a depth of not less than 2 inches, and placing new concrete which shall be formed with keys, dovetails or anchors to attach it securely to the other work. One anchor shall be placed for each 64 square inches of area and the sides of the cut areas shall be generally rectangular. This concrete shall be drier than the usual mixture and shall be thoroughly tamped into place behind forms securely fastened. Unless otherwise specified, all surfaces of concrete not covered by forms, that are not to be covered by additional concrete, or backfill, shall have a wood float finish without additional mortar, and shall be true to elevations as shown on the drawings. Care shall be taken to see that all excess water is removed before making this finish. Other surfaces shall be brought to the specified finished elevation and left true and regular as approved by the contracting officer. Where considered necessary by the contracting officer, or where indicated on the drawings, joints shall be carefully made with a jointing tool. Every precaution shall be taken by the contractor to protect finished surfaces from stains or abrasions. No fire shall be permitted in direct contact with any concrete at any time. Concrete surfaces or edges likely to be injured during the construction period, shall be properly protected by leaving the forms in place, or by erecting covers satisfactory to the contracting officer.

b. Special finishing. - As soon as possible, after removal of the forms and before the concrete has become too hard, exterior areas where specified or required shall be thoroughly wetted and rubbed with fairly coarse carborundum stone until paste is formed on the surface. The rubbing shall continue until all deformities have been removed and a smooth, even surface exists, but in no event shall the coarse aggregate of the concrete be exposed. A fine carborundum stone shall be used in obtaining the final finish, producing a fine paste which shall be allowed to take a "reset" leaving the entire exterior concrete uniform

in texture and color, blending exactly with the adjacent special finish concrete work. After the surface has hardened and been accepted by the contracting officer, it shall be cleaned and dusted with canvas, and shall be free from all unsound patches, paste, lather, powder, and objectionable marks. Any surface which has been disfigured by drippings from the placing or finishing of parts above shall be cleaned, using a weak solution of muriatic acid, if necessary, all of which shall be executed to the satisfaction of the contracting officer.

7-16. Curing. - a. Warm weather. - All concrete shall be adequately protected from injurious action by the sun. Fresh concrete shall be protected from heavy rains, flowing water, and mechanical injury. All concrete shall be kept wet for a period of not less than 14 days by covering with water, or with an approved water-saturated covering, or by a system of perforated pipes or mechanical sprinklers, or any other approved method which will keep all surfaces continuously (not periodically) wet. Where wood forms are left in place for curing, they shall be kept wet at all times to prevent opening at the joints and drying out of the concrete. Water for curing shall be generally clean and entirely free from any elements which in the opinion of the contracting officer might cause staining or discoloration of the concrete.

b. Cold weather. - Concrete when placed during cold weather shall be kept moist and provided with adequate protection for a period of not less than 14 days, subject to the approval of the contracting officer, so that the air in contact with the concrete will be maintained at temperatures between 50 degrees F. and 70 degrees F. for at least the first 5 days of the curing period. For massive sections, where the atmospheric temperatures are sufficiently low in the opinion of the contracting officer to cause excessively rapid cooling and contraction of the exterior surfaces, this period for maintaining the temperature of the air in contact with the concrete between 50 and 70 degrees F. shall extend over the entire curing period. Salt or other chemicals shall be admitted into the mixture to prevent freezing except with the approval of the contracting officer.

FORMS, REINFORCEMENT AND PAYMENT

7-17. Forms. - a. Materials. - Forms shall be of wood, steel or other approved material, except that where lining is not specified, the sheeting for all exposed surfaces shall be tongue-and-groove lumber of uniform width unless otherwise specifically authorized. Forms of like character shall be used for similarly exposed surfaces in order to produce a uniform appearance. The type, size, shape, quality and strength of all materials of which the forms are made shall be subject to the approval of the contracting officer.

b. Construction. - Forms shall be built true to line and grade, and shall be mortar-tight and sufficiently rigid to prevent displacement or sagging between supports. Responsibility for their adequacy shall rest with the contractor. Their surfaces shall be smooth and free from irregularities, dents, sags, or holes when used for permanently exposed faces. Bolts and rods used for internal ties shall be so arranged that, when the forms are removed, all metal will be not less than 2 inches from any concrete surface. Wire ties will not be permitted where the concrete surface will be exposed to weathering and discoloration will be objectionable. All forms shall be so constructed that they can be removed without hammering or prying against the concrete. Unless otherwise indicated, suitable moldings shall be placed to bevel or round exposed edges, at expansion joints or any other points as may be required by the contracting officer.

c. Coating. - Forms for exposed surfaces shall be coated with a non-staining mineral oil which shall be applied before the concrete is placed. After oiling the forms the excess oil on the surfaces shall be removed by wiping with dry rags or waste. Forms for unexposed surfaces may be thoroughly wetted in lieu of oiling, immediately before the placing of concrete, except that in freezing weather oil shall be used.

d. Removal. - Forms shall not be removed without the approval of the contracting officer, and all removal shall be accomplished in such manner as will prevent injury to the concrete. Forms shall not be removed before the expiration of the minimum number of days indicated below, except when specifically authorized by the contracting officer. When, in the opinion of the contracting officer, conditions on the work are such as to justify it, forms may be required to remain in place for longer periods.

Arches, beams and slabs	7 days
Columns	3 days
Walls and vertical faces	2 days

e. Form lining. - In addition to the requirement for work specified above, wood forms for walls which will be visible in the finished structure, and at other locations indicated on the drawings or as directed by the contracting officer, shall be lined with sheet steel or with pressed wood sheets of Masonite or approved equal. Lining shall be applied directly to the sheeting. The jointing of the lining shall be neat and close and no patch pieces, plugs, cleats or blocking will be permitted. Overrun of lining shall be trimmed to secure proper fit to adjoining surfaces. Lining with bruises, imprints or hammer marks shall not be used.

7-18. Furnishing, bonding, and placing steel reinforcement (Item 14). - a. Work included. - (1) The contractor shall furnish, cut, bend and build into the concrete, in accordance with the drawings and directions, all reinforcing steel of deformed bars, dowels or anchors.

(2) Steel reinforcement may be cut and bent at the mill or in the field. All bending shall be in accordance with standard approved practice and by approved machine methods.

b. Materials. - Reinforcing steel shall be of new, billet intermediate grade, open-hearth steel, deformed, and shall conform to the Federal Specifications QQ-B-71a for "Bars, reinforcement concrete, Type "B", Grade 2 (dated January 12, 1938)". Certified copies of any mill test shall be furnished by the contractor and the steel shall be subjected to such tests as the contracting officer may consider necessary to establish its quality, including particularly the requirements of bonding and elongation. The steel shall be free from oil, paint, dirt or excessive rust.

c. Placing. - (1) All steel reinforcement shall be placed in the exact positions and with the spacing shown on the drawings or ordered, and it shall be so fastened in position as to prevent its becoming displaced during the placing of the concrete. The clear distance between parallel rods shall be not less than one and one-half times the diameter of round rods, or twice the side dimensions of square rods, and unless specifically authorized, shall in no case be less than 1 inch.

(2) Except where otherwise indicated, reinforcement shall be placed as follows:

(a) All main reinforcement shall be placed not less than 4 inches from any surface, except in slabs.

(b) All main reinforcement in slabs, exposed to the weather, shall be placed not less than 1 inch from the surface. The covering of stirrups, spacer rods, and similar secondary reinforcement may be reduced by the diameter of such rods. The above dimensions shall be measured from the face of the reinforcement to the face of the forms.

(c) Where splices in reinforcement, in addition to those indicated, are necessary, there shall be sufficient lap to transfer the stress by bond as may be directed. Rods shall be lapped not less than 40 diameters and splices shall be staggered. The lapped ends of rods shall be separated sufficiently or connected properly to develop the full strength of rod. Adjacent sheets of mesh reinforcement shall be spliced by lapping not less than 6 inches, the lapped ends being securely wired together.

d. Protection. - Steel for reinforcement shall be new unrusted stock, free from loose scale. It shall be at all times satisfactorily protected from moisture until placed in final position. Ends of rods that are to be left projecting for a considerable time shall be painted with a heavy coat of neat cement grout.

7-19. Embedded items. - General. - In addition to reinforcing steel, there shall be built into, or set, or attached to the concrete, pipes, and other metal objects as shown on the drawings or ordered. All necessary precautions shall be taken to prevent these objections from being displaced, broken or deformed. Before placing concrete, care shall be taken to determine that any embedded metal or wood parts are firmly and securely fastened in place as indicated. They shall be thoroughly clean and free from paint or other coating, rust, scale, oil, or any foreign matter. The embedding

of wood in concrete shall be avoided whenever possible, metal being used instead. The concrete shall be packed tightly around pipes and other metal work so as to prevent leakage and secure perfect adhesion. Gravel drains shall be adequately protected from intrusion of concrete into them. Payment for this work is included in the several items for gravel drains and metal work.

7-20. Expansion and contraction joints. - Expansion and contraction joints shall be constructed true to line and grade at such points and of such dimensions as may be indicated or required. The method and materials used shall be subject to the approval of the contracting officer and the materials shall conform to Federal specifications wherever applicable. Unless otherwise indicated on the drawings, or required by the contracting officer, expansion joints shall be made by coating concrete surfaces with two coats of approved asphaltic emulsion or a single coat of bituminous cement to which premoulded sponge rubber or compressed cork filler 3/8" thick shall be applied and such filler thoroughly covered with asphaltic emulsion or bituminous cement as specified above. In no case shall corner protection angles or other fixed metal embedded in the surface of the concrete and bonded, be continuous through an expansion joint. Payment for all expansion joint material shall be included in the contract unit price for concrete.

7-21. Measurement and payment. - a. Portland cement (Item 13). - (1) The quantity to be paid for under Item 13 will be the number of barrels of cement used in all parts of the work unless specifically excepted. For purposes of payment, a barrel of cement shall be considered 376 pounds net of cement. The contract unit price for the cement shall include payment for all expenses incidental to delivering the cement upon the work in which it is to be used.

(2) Only the cement furnished for work to be done under Items 15 to 17 inclusive, will be paid for under Item 13. Cement used for mortar or grout under other items will be included in the payment for those items.

b. Concrete (Items 15 to 17 inclusive). - See Section VIII.

c. Reinforcement (Item 14). - The quantity to be paid for under Item 14 will be the number of pounds of steel placed in accordance with the drawings or orders, measured as specified. It will not include any waste material due to the fact that the lengths supplied are too long for their purpose. The quantity paid for will, however, include extra metal in laps, where authorized, due to the fact that single bars would be unreasonably long. In computing the weights, one cubic inch of steel shall be assumed to weigh 0.2833 pounds, and the weight of the deformed bars shall be taken at the theoretical weight of plain bars and be used as tabulated in Federal Specification QQ-B-719 for the length ordered. Wire or metal clips, and other supports necessary to hold the steel in place will not be considered as reinforcement but shall be furnished by the contractor without additional compensation. The contract unit price for Item 14 shall include furnishing, bending, cutting, placing, fastening in position, coating, protecting the reinforcement and all other work and materials connected herewith. (See Paragraph 7-18a).

SECTION VIII. CONCRETE STRUCTURES (Items 15 to 17 incl.).

8-01. General. - a. Description. - Concrete structures shall be constructed as shown on the drawings or as directed by the contracting officer. Concrete shall conform to all the requirements of Section VII for concrete of the class specified. Surfaces of concrete shall be finished as specified in Paragraph 7-15, except as otherwise specified in this section or indicated by the drawings.

b. Measurement and payment. - The quantity to be paid for under Items 15 to 17 inclusive, will be the number of cubic yards of concrete satisfactorily placed within the required limits. No deductions shall be made for openings having a cross-sectional area less than that of a 12-inch pipe, nor for the space occupied by reinforcing steel, miscellaneous metal, wood nailing strips, or by other materials required to be built into the concrete. The unit contract prices shall include payment for all costs of furnishing materials, erecting and removing forms, mixing and placing concrete, furnishing and placing expansion joint materials, and waterproofing. Cement, reinforcing steel and other metal work are included under other items. (See Paragraph 7-21).

8-02. Concrete in bridge deck (Item 15). - a. Description. - This classification includes the Class "A" concrete required for the bridge deck placed between the limiting lines and grades, and in the required location, as shown on the drawings or directed by the contracting officer. Forms for exposed surfaces shall be lined with plywood or pressed wood, "Masonite" or equal. Concrete fins formed on exposed surfaces shall be removed after the forms are stripped. Piping, drains and miscellaneous metal work shall be set and concreted in place as provided for on the drawings.

b. Concrete bridge. - (1) Falsework and forms shall be constructed to produce, in the finished structure, the permanent camber as shown on the drawings and in accordance with Paragraph 7-17. Construction joints shall be made in girders, slabs and curbs as indicated on the drawings.

(2) Concrete shall be deposited simultaneously and uniformly in the girders and in accordance with Section VII. Extreme care shall be exercised in placing concrete in bridge railings to insure smooth surfaces true to lines and grades. The exterior surfaces shall receive special finishing. (See Paragraph 7-15b).

(3) The ducts under the sidewalk shall have the sides and bottom water-proofed by the application of one coat of asphalt primer conforming to A.S.T.M. specifications D.41-26 and two coats of asphalt for water-proofing conforming to A.S.T.M. specifications D.144-25. Concrete surfaces shall be allowed to dry at least five days before application of water-proofing is applied and each coat shall be thoroughly dry before the successive coat is applied.

c. Measurement and payment. - (1) The volume of concrete to be paid for will be the volume computed between the limiting lines and grades, as shown on the drawings or directed by the contracting officer.

(2) Payment for the Class "A" concrete in the bridge deck will be made at the contract unit price for Item 15.

8-03. Concrete in highways (Item 16). - a. Description. - This classification includes Class "A" concrete required for concrete highway pavement as shown on the drawings. The concrete pavement shall be constructed on a prepared and compacted subgrade in one course, and include furnishing and placing bituminous joint filler, as shown on the drawings or as directed by the contracting officer. Forms shall be of metal of an approved cross-section, of a depth equal to the required edge thickness of the concrete, provided with adequate devices for secure setting, and shall be set true to line and grade. Wire mesh reinforcement shall conform to A.S.T.M. specifications A185-36T and shall be placed as shown on the drawings. The strips of wire mesh reinforcement shall overlap not less than 6 inches. Dowels shall conform to the requirements of Paragraph 7-21c and shall be accurately placed as shown on the drawings. The concrete shall be finished by a hand screeding template and belt as directed by the contracting officer, and completed by brooming. As soon as finished, the concrete shall be protected by heavy burlap and properly cured (see Paragraph 7-16). Finished surfaces shall be so smooth that when a 10-foot straight edge is laid upon them, parallel with the center line of the highway, the surfaces shall in no place vary more than 1/4 inch from the lower edge of the straight-edge, except at grade changes. High points shall be reduced by bush hammering or rubbing with carborundum stone.

b. Measurement and payment. - The volume of concrete to be paid for will be the volume computed between the limiting lines and grades, as shown on the drawings or directed by the contracting officer. Payment for Class "A" concrete in highways will be made at the contract unit price for Item 16.

8-04. Concrete in drop structure, canal wall, and bridge pier and abutments (Item 17). - a. Description. - This classification includes the Class "B" concrete required for the drop structure, canal walls, and the center pier and abutments of the bridge, as shown on the drawings or directed by the contracting officer. The concrete pavement in the drop structure shall be constructed on a prepared and compacted subgrade, in one course, and include expansion joints made by use of premoulded sponge rubber 1/4 inch in thickness, as shown on the drawings. Expansion joints in the footings of the canal walls shall be made as required in Paragraph 7-20.

b. Measurement and payment. - The volume of concrete to be paid for will be the volume computed between the limiting lines and grades, as shown on the drawings or directed by the contracting officer.

Payment for Class "B" concrete placed in the drop structure, canal walls, and bridge pier and abutments will be made at the contract unit price for Item 17.

SECTION IX. METALS AND EMBEDDED ITEMS (Items 18 to 22 incl.).

9-01. General. - All metals, unless otherwise specified, shall conform to applicable Federal Specifications, and, when not covered thereby, to applicable A.S.T.M. specifications. All castings shall have the pattern or mark number cast on them. Unless otherwise authorized by the contracting officer, the scale weights of each casting or forging after machining shall be within 5 per cent of the weights as calculated from the dimensions specified or shown on the drawings. Castings shall conform, at the minimum section thereof, to the following dimensional tolerances: where embedded in concrete, to within 1/8 inch; where not embedded in concrete, to within 1/16 inch of the dimensions shown on the drawings.

9-02. Materials and workmanship. - a. The articles included in Items 18 to 22, inclusive, other miscellaneous materials, and all metals required in the work except as otherwise specified, shall meet the requirements of the following specifications where applicable to the use intended:

(1) Structural steel: - Federal Specification QQ-S-711a; shapes, plates, bars, pins and bolts shall be Class "A" and rivets shall be Class "C", unless otherwise required. Welding will be accepted only where specified or authorized, and approved only when done in accordance with the current requirements of the American Bureau of Welding.

(2) Cold-rolled steel: - A.S.T.M. Specifications A-108-36 for "Commercial Cold-finished Bar Steels and Cold-finished Shafting." Unless otherwise specified this material shall be used for rods, pins, keys, and similar parts.

(3) Hot-rolled steel, for shafting, sleeves and rollers: - A.S.T.M. Specifications A-107-36 for "Commercial Quality Hot-rolled Bar Steels."

(4) Machine steel, same as for Hot-rolled steel.

(5) Steel, corrosion resisting: - U. S. Navy Specification 46-S-18b.

(6) Steel forgings, shall be of hot-rolled open-hearth steel forging bars conforming to A.S.T.M. Specifications A-18-30 for carbon steel and alloy steel forgings, Class "C", except that shafts of this material not otherwise specified shall be S.A.E. No. 1045 hot-rolled, open-hearth steel forging bars.

(7) Steel castings: - Federal Specification QQ-S-681a.

(8) Iron castings, gray: - Federal Specification QQ-I-651, class as indicated. Tensile tests and chemical analysis will not be required.

(9) Iron castings, semi-steel: - Federal Specification QQ-I-656 for "Iron Castings, High Test (semi-steel)", class as indicated. Tensile tests will not be required.

(10) Malleable iron castings: - Federal Specification QQ-I-666, Type "A".

(11) Steel rail track and fittings, shall be standard A.S.C.E. sections and shall conform to the A.R.E.A. standard specification for carbon steel rails.

(12) Chains and attachments: - Federal Specification RR-C-271 for Type "A" and Grade "2" unless otherwise specified.

(13) Bolts, screws, and washers: - Appropriate Federal Specification and current standard practice, unless otherwise specified.

(14) Wrought-iron bars and shapes: - Federal Specification QQ-I-686, Grade "B".

(15) Cast-iron pipe: - A.S.T.M. Specifications A-44-04, Class "A"; for soil pipe refer to Federal Specification WW-P-401.

(16) Black steel pipe: - Federal Specification WW-P-403, Type "A", and WW-P-521.

(17) Sheet copper: - Federal Specification QQ-C-501, Type "V", Class "A".

(18) Zinc coatings (hot galvanized: - Federal Specification QQ-I-696.)

(19) Babbitt metal: - Federal Specification QQ-M-161.

(20) Lead: - Federal Specification QQ-L-171, Grade "A".

(21) Solder: - Appropriate Federal Specification QQ-S-571 and QQ-S-551.

(22) Valves: -Federal Specification WW-V-76a.

(23) Wrought-iron pipe: - Federal Specification WW-P-441.

(24) Wrought Phosphor Bronze: - A.S.T.M. Specification for bearing and expansion plates, wrought phosphor bronze, for bridges and structures No. B100-35T.

(25) Other items, unless otherwise specified, shall conform to current standard practice for the material required and use intended.

9-03. Galvanizing and painting. - a. Galvanized iron or steel articles, as indicated on the drawings, shall be galvanized by the hot-dip process unless otherwise permitted. Injuries to the galvanizing shall be satisfactorily repaired. Provision shall be made for protecting threads either by counter-boring fittings, so as to cover threads or by cutting threads so as to make a very loose fit before galvanizing and carefully rerunning threads after galvanizing so as to leave a good coating all over threads. Hot galvanizing shall be of such quality as to endure at least 4 one-minute immersions in copper sulphate solution, in accordance with the requirements of the Preece test.

b. All metal to be exposed in the finished work shall be thoroughly cleaned and then thoroughly and evenly painted with one coat of red lead paint and two coats of an approved lead-and-oil paint to the satisfaction of the contracting officer. No painting shall be done until the condition of the surface to be painted has been approved. The paint shall be applied by either brush or spray in a neat, thorough, and workmanlike manner, and in no event shall any paint be applied in freezing, rainy, or misty weather. The paint used shall conform to the requirements of Federal Specifications of Group "TT"; and samples of paint shall be submitted to the contracting officer for approval and selection.

9-04. Pipe handrailing (Item 18). - a. Classification. - Pipe handrailing will be classified as follows:

(1) Pipe handrailing, canal walls (Item 18a).

(2) Pipe handrailing, bridge (Item 18b).

b. Description. - The contractor shall furnish and install pipe handrailings, fittings and accessories required for the canal walls and for the bridge as shown on the drawings or directed by the contracting officer. Recesses shall be left in the concrete to receive the railing posts, and the railings shall be completely assembled and accurately grouted into position and alignment.

c. Materials and workmanship. - The materials for handrailing shall conform to Federal Specifications (see Paragraph 9-02). Railings shall be installed as shown on the drawings. Weldedjoints shall be made by qualified welders. The assembly shall be such as to permit good welding and welding shall not be used to close openings larger than required for proper assembly. Expansion joint and filler material shall be furnished and placed as shown on the drawings. All exposed metal in handrailings shall be painted in accordance with Paragraph 9-03b.

d. Measurement and payment. - The quantities to be paid for under Items 18a and 18b, will be the number of linear feet of pipe handrailing furnished and installed in accordance with the drawings and specifications. Payment for Pipe Handrailing for Canal Walls, and Pipe Handrailing for Bridge will be made at the contract unit prices for Items 18a and 18b, respectively, which shall include the costs of all labor,

materials, equipment and incidentals required to install the handrailings as specified.

9-05. Miscellaneous iron and steel (Item 19). - a. The contractor shall furnish and install cast iron and pipe drains, structural steel angle with anchors for curb edging, steel plates with angles, bolts and anchors for expansion joint at the junction of the highway pavement with the bridge, steel bearing expansion plates with bolts for the bridge seats, steel guides, bolts and accessories for the stop-log structures, and all other miscellaneous iron and steel articles shown on the drawings or required, except pipe handrailing and other articles specified elsewhere.

b. Payment will be in accordance with Paragraph 9-08b.

9-06. Copper water stops (Item 20). - a. Copper water stops required for the construction joints and expansion joints of concrete work shall be furnished and installed. Copper water stops used in concrete expansion and construction joints shall be continuous, and shall be crimped for expansion joints only. Splicing of the water stops shall be done by overlapping, brazing and soldering. Unless otherwise specified on the drawings the material shall be sheet copper conforming to Federal Specification (see Paragraph 9-02) weighing 20 ounces per square foot. At expansion joints the crimp shall be filled with a mastic filler of "elastite" as manufactured by Philip Carey Co., Cincinnati, Ohio, or equal. Copper water stops shall be placed in the expansion joints indicated on the drawings, and in all construction (field) joints as directed by the contracting officer.

b. Payment will be made in accordance with Paragraph 9-08b.

9-07. Phosphor-bronze plates (Item 21). - a. The contractor shall furnish and install phosphor-bronze bearing expansion plates, conforming to Federal Specifications (see Paragraph 9-02), between the steel bearing expansion plates on the bridge seats of the sizes required, as shown on the drawings.

b. Payment will be made in accordance with Paragraph 9-08b.

9-08. Sheet lead (Item 22). - a. The contractor shall furnish and install a sheet lead cap on the back wall of the bridge abutments, as shown on the drawings. Sheet lead to be used shall be approved by the contracting officer.

b. Measurement and payment. - The quantities to be paid for under Items 19 to 22, inclusive, will be the number of pounds respectively furnished and installed in accordance with the drawings and specifications. Wherever practicable, the quantities shall be determined by weighing the articles and materials on the most accurate scales available. When weighing is not practicable, the weight will be determined by the contracting officer, who will use for that purpose scale weights, railroad shipping

weights, manufacturers' weights, catalog weights, or computed weights. The weight of all tare, packing, and blocking will be deducted, using only net weights for payment quantities; provided, that no payment will be made for any weight in excess of 5 per cent more than the computed weight as determined from the drawings.

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SECTION X - MISCELLANEOUS (Items 23 to 26 incl.)

10-01. Surfacing for roads (Item 23). - a. Work included. - The contractor shall furnish and place gravel of the sizes and quality specified or directed with a clay binder for the surfacing and shoulders of roadways and for the surfacing of the bridle path, and the temporary detour, to the lines and grades shown on the drawings.

b. Material. - The gravel shall be composed of hard durable stones free from thin or elongated pieces, together with sand and clay or other approved binding material. It shall be of such sizes for the bottom course that all will pass a screen with 3-inch square openings and not less than 40 per cent will be retained on a screen with 1/4-inch square openings; and for the top course all will pass through a screen with 3/4-inch square openings, and not less than 35 per cent will be retained on a screen with 1/4-inch square openings; and for either course it shall be uniformly graded. The finer material shall consist of sand and clay or other binding material approved by the contracting officer. Should the material as received for the work fail to maintain suitable proportions of coarse and fine particles, or should the coarse particles not be uniformly graded between the maximum and minimum sizes as specified, it shall be screened or mixed in such a manner as to furnish a material to meet the above requirements.

c. Placing. - (1) The 12-inch gravel surfacing shall be placed in two layers, a base course and a top course, each 6 inches thick after compaction. After the subgrade or foundation shall have been properly prepared and compacted and proper drainage provided, the bottom course of the material shall be spread evenly by means of approved spreader vehicles or trucks. The material as spread shall be well-graded with no pockets of fine material or segregation of large and fine particles. After being spread evenly, the material shall be thoroughly compacted, by rolling with a self-propelled three-wheel roller weighing not less than ten tons, until a firm even surface is obtained. After the bottom course has been properly and satisfactorily compacted the top course shall be spread and compacted to the required thickness. If at any time the material does not contain a sufficient amount of moisture to insure proper binding of the material, water shall be added by means of a sprinkling wagon or any approved method in a sufficient amount to obtain the desired results. Rolling shall start longitudinally at the side and gradually proceed toward the center of the roadway overlapping on successive trips. During the process of rolling the material shall be dragged; the dragging and rolling shall continue until the gravel does not creep or wave under the roller.

(2) The 6-inch gravel surfacing shall be placed in one layer 6 inches thick after compaction. Material and workmanship shall conform to that specified above for the top course of the 12-inch gravel surfacing.

d. Shoulders. - Shoulders shall be composed of gravel, practically free from loam and with all stones larger than four inches removed. Before the final completion of the work the shoulders shall be reformed, trimmed, raked and rolled.

e. Bridle path. - The bridle path across the bridge shall be placed in two courses, each 6 inches in thickness after compaction. The base course shall be composed of a gravel and clay mixture as provided in d above and shall be consolidated with water to the extent directed so that no settlement or voids will later result. The top course shall be composed of gravel with clay binder as provided in Paragraph 10-01b. The top course shall be placed in layers two inches in thickness and compacted by the use of hand or mechanical tampers, adding water with an approved sprinkler, if necessary, to obtain desired results. The finished surface of the bridle path shall be firm and even.

f. Measurement and payment. - The quantity to be paid for under Item 23 will be the number of cubic yards furnished and placed in accordance with the drawings or as directed by the contracting officer. The gravel will be measured in place after compacting. Payment will be made at the contract unit price for Item 23, "Gravel for Roads." The contract unit price shall include payment for all expenses incidental to furnishing, mixing, placing, and rolling or otherwise compacting the gravel surfacing and maintaining the detour roadway.

10-02. Bituminous macadam road surface (Item 24). - a. Work included. - The contractor shall furnish and place the bituminous macadam road surface shown on the drawings, in the locations shown on the drawings or otherwise designated by the contracting officer, after the gravel base shall have been placed in accordance with the drawings and the provisions of Paragraph 10-01. The bituminous macadam construction is required to surface the highways. The surface course shall be composed of broken stone and bituminous material applied by the penetration method, with a bituminous seal coat and covering of pea stone.

b. Materials. - The broken stone for the surface course shall consist of clean crushed rock, thoroughly screened, uniformly graded in size and quality, angular and free from rounded surfaces; and no flat, elongated or otherwise objectionable stone shall be used. All stone shall meet the following requirements.

No. 1 Stone Square openings	Per cent passing
2-1/4"	90-100
1-1/4"	0- 40
3/4"	0- 5

Pea stone Square openings	Per cent passing
1/2"	90-100
1/4"	0- 20

The bituminous material to be used in this work shall be an approved product for the purpose, either oil asphalt or refined tar. (See Federal Specification R-T-121 for grades TP-1-25 or TP-2-25.)

c. Placing. - (1) Shoulders shall be relined and graded before the surface course is spread, in order to hold the broken stone in place and to permit the roller to lap at least one-half the width of the rear wheel when rolling the edge of the top course. A course of No. 1 stone shall then be spread upon the prepared base course to the ordered depth shown on the drawings and dry rolled. The rolling shall be done by a self-propelled three-wheel roller weighing not less than 10 tons. Before the No. 1 stone is spread, the pea stone shall be deposited along the shoulders in convenient piles, from which it shall be spread on the surface course as directed. No hauling will be permitted over the No. 1 stone after it has been spread.

(2) The No. 1 stone shall be spread from approved self-spreading vehicles. The course shall be spread and shaped to a true section of such depth that when the surface is finished, the depth shall be as shown on the drawings and the top surface shall be at the required grade. Rolling shall continue until the course has been satisfactorily compacted to a uniform surface. Any depressions or irregularities which may occur shall be filled with broken stone as directed, and again rolled until the surface is true and unyielding. Precautions shall be taken to prevent the depositing of dirt or other materials in the voids of the broken stone.

(3) No bituminous material shall be applied on stone which has become coated or mixed with dirt or foreign substances. No bituminous material shall be applied unless the entire depth of No. 1 stone is thoroughly dry and the air temperature is at or about 50 degrees F. After the No. 1 stone has been prepared as above, the penetration coat of bituminous material shall be applied at the rate of 2 gallons per square yard by an approved pressure distributor, at approved temperatures appropriate for the grade of bituminous material used, and distributed under approved pressures of from 40 to 60 pounds per square inch.

(4) Immediately after the penetration coat of bituminous material has been applied, a thin layer of clean, dry pea stone shall be broadcast over the treated surface in such quantity as to fill all the surface voids and just cover the treatment uniformly. The surface shall then be broomed to break up all clumps and produce a uniform covering, after which the pavement shall be rolled, in the same manner as specified for the rolling of No. 1 stone, until thoroughly compacted and bonded. Additional pea stone shall be applied as required and directed. Upon completion of the rolling the pavement shall have a smooth, even surface, free from ruts, depressions, or other irregularities.

(5) As soon as practicable after the pea stone has been rolled, the pavement shall be swept clean of any loose material and shall be treated with a seal coat of bituminous material under the same conditions and in the same manner as specified for the penetration coat;

except, that the rate of application shall be 3/4 gallon per square yard. Immediately after the seal coat has been applied, a thin layer of clean dry pea stone shall be broadcast over the surface in such quantity as to uniformly cover the surface with all the stone that can be made to adhere to the bituminous material, care being taken to avoid an excess. This stone shall be broomed and rolled in the manner specified above, until an unyielding, uniform and well-bonded surface is produced. Any damage to the unfinished surface caused by the working equipment or otherwise, shall be satisfactorily repaired.

d. Measurement and payment. - The quantity to be paid for under Item 24 will be the number of square yards of bituminous macadam surface of the required quality and thickness satisfactorily placed in the work, measured after placing. Payment will be made at the contract unit price for Item 24 "Bituminous Macadam Road Surface," which shall include all cost of furnishing materials, equipment, tools, labor and all work incidental to satisfactory construction.

10-03. Highway guard rail (Item 25). - a. Work included. - The contractor shall furnish and install cable guard rail at the locations as shown on the drawings or directed by the contracting officer.

b. Materials. - (1) Posts shall be constructed of Class "A" reinforced concrete to the sizes and dimensions as shown on the drawings. The maximum size of coarse aggregates shall not exceed one inch in size. The reinforcement shall conform to the requirements of Paragraph 7-18.

(2) The wire rope shall be 3/4 inch diameter, conforming to the requirements of Federal Specification RR-R-571 and subsequent amendments thereof, Type III, 3 by 7 wire rope, annealed steel, galvanized.

(3) All fittings for highway guard rail, except anchor rods, nuts and washers, shall be of galvanized drop forgings, conforming to Class "B" of A.S.T.M. Designation A18-30". Nuts and washers shall conform to Paragraph 9-02. The cables shall be fastened to the concrete posts with offset fittings and to the anchor blocks as shown on the drawings. The fasteners on the end posts and on the posts where intermediate anchorages are made, shall be steel provided with a bearing bracket. Each cable shall be attached to its respective socket by hot zinc socketing conforming to Federal Specification RR-R-571, Paragraph 1-12.

c. Construction methods. - The posts for the highway cable guard rail shall be spaced and securely set and the cable strung as shown on the drawings or as directed by the contracting officer. Backfilling shall be thoroughly tamped into place. Each anchor and end post shall have a footing of concrete or a single stone at least 12 inches square and four inches thick as shown on the drawings. The cable shall be drawn taut and anchored by a precast concrete anchor block or other anchorage approved by the contracting officer. Dummy posts, other than those at the ends of cable guard rails, shall be placed to mark culverts or elsewhere as ordered.

After erection all exposed surfaces of the posts shall receive a uniform application of a solution consisting of 8 pounds of zinc sulphate to one gallon of water. This application shall be allowed to set for at least 48 hours after which the posts shall be brushed thoroughly to remove any surface crystals of zinc sulphate. The posts, when perfectly dry, shall receive two coats each of white paint and black paint as directed. The black paint shall extend from the ground up to the bottom cable. The posts shall be thoroughly dried out and aged before the application of any paint materials.

d. Payment. - Payment for all work, materials and incidentals required for the erection of highway guard rails as above set forth, and at the locations as shown on the drawings, will be made at the contract unit price for Item 25, "Highway Guard Rail."

10-04. Precast concrete stop-logs (Item 26). - a. Work included. - Precast concrete stop-logs shall be furnished and installed or stored for the stop-log structures at the locations shown on the drawings or as directed by the contracting officer.

b. Materials. - The stop-logs shall be cast in conformity with the requirements for Class "A" concrete (see Section VII). The steel reinforcement shall conform to the provisions of Paragraph 7-18. The concrete members shall be free from depressions and spalls, patched or plastered surfaces or edges, or any other defects which may impair their strength or durability. Cracked or otherwise defective concrete logs will be rejected.

c. Description. - Stop-logs shall be carefully cast to fit the stop-log structures, and shall be installed as shown on the drawings or stored as directed by the contracting officer.

d. Measurement and payment. - Measurement for payment will be based on the number of linear feet furnished and installed or stored. Payment will be made at the contract unit price for Item 26, "Precast Concrete Stop-Logs," and shall include all costs of furnishing and installing or storing the precast concrete stop-logs.

10-05. Cleaning up. - a. Work included. - The contractor shall remove all construction equipment and all temporary structures built or used by him, shall remove rubbish of all kinds from the site of the work, and from any grounds which he shall have occupied within the limits of the work, and shall leave the site of the work in a clean condition satisfactory to the contracting officer. All materials salvaged shall be the property of the contractor.

b. Payment. - For all work, materials and incidentals required to clean up as set forth in a above, the contractor will receive no direct payment, but payment shall be considered as having been included in the contract prices for Items 1 to 26 inclusive.

UNITED STATES ENGINEER OFFICE,
PROVIDENCE, RHODE ISLAND,
MAY 29, 1939.

Invitation No. 699-39-325
(Date)

STANDARD GOVERNMENT FORM OF BID

(Construction Contract)

(Place) _____

(Date) _____

To the District Engineer,
U. S. Engineer Office,
819 Industrial Trust Bldg.,
Providence, R. I.

In compliance with your invitation for bids dated _____,

and subject to all the conditions thereof, the undersigned

_____

a corporation organized and existing under the laws of the State of

_____

a partnership consisting of _____

_____

_____

_____

or an individual trading as _____

_____

_____

of the city of _____

hereby proposes to furnish all plant, labor, and materials, and perform all work required for the construction of a portion of the diversion canal for the Mill River at Northampton, Massachusetts, including all work indicated on the drawings, or required by the specifications, and such incidental work as needed or ordered in writing by the contracting

officer, in strict accordance with the specifications, schedules, and drawings, for the consideration of the following prices:

Item No.	Designation	Unit	Quantity	Unit Price	Amount
1	Preparation of Site	acres	6.25		
2	Stripping	cu.yds.	6,100		
3	Excavation, Common	" "	75,600		
4	Steel Sheet Piling	sq.ft.	14,100		
5	Timber Piling	lin.ft.	27,900		
5A	(Alternate to Item 5)				
	(1) Timber Piling	" "	20,200		
	(2) Reinforced Concrete Piling	" "	3,850		
6A	Screened Gravel	cu.yds.	900		
6B	Crushed Stone	" "	150		
7	Compacted Backfill	" "	2,000		
8	Semi-compacted Backfill	" "	5,200		
9	Highway Embankment	" "	10,000		
10	4-Inch Tile Pipe	lin.ft.	1,030		
11	Corrugated Metal Pipe				
	a. 18-Inch	" "	41		
	b. 36-Inch	" "	70		
12	Riprap				
	a. Derrick Stone	cu.yds.	1,140		
	b. Hand-Placed	" "	400		
13	Cement	bbls.	6,600		
14	Steel Reinforcement	lbs.	440,000		
				Carried forward $	

Item No.	Designation	Unit	Quantity	Unit Price	Amount
15	Class "A" Concrete in Bridge	cu.yds	530		
16	Class "A" Concrete in Highways	" "	350		
17	Class "B" Concrete	" "	4,710		
18	Pipe Hand-Railing				
	a. Canal Walls	lin.ft	385		
	b. Bridge	" "	175		
19	Miscellaneous Iron and Steel	lbs.	14,600		
20	Copper Water Stops	"	765		
21	Phosphor-Bronze Plates	"	160		
22	Sheet Lead	"	1,300		
23	Surfacing for Roads	cu.yds	2,900		
24	Bituminous Macadam Surface	sq.yds	4,300		
25	Highway Guard Rail	lin.ft	470		
26	Precast Concrete Stop-Logs	lin.ft	106		
TOTAL BID					

Notes: - (1) All amounts and total given above will be subject to verification by the Government. In case of variation between unit bid price and totals shown by bidder, the unit price will be considered to be his bid.

(2) All bids must be for the entire work and must have each blank space filled.

(3) The quantities of each item of the bid as finally ascertained at the close of the contract, and the unit prices of the various items stated by the bidder in the accepted bid, will determine the total payments to accrue under the contract. The unit price bid for each item must allow for all collateral or indirect costs connected with it.

PLANT TO BE USED ON THE WORK

(See Invitation for Bids and Paragraph 1-09 of the specifications)

Note: - Use separate line for each major item.

No.	Name	Kind	Capacity	Age and Condition

Material Handling Equipment

Pumping Equipment

Excavating Equipment

Concreting Equipment

Pile Driving Equipment

Bituminous Surfacing Equipment

Miscellaneous Equipment

EXPERIENCE. - (See Invitation for Bids)

LIST OF PERSONS EXPECTED TO BE EMPLOYED

(See Paragraph IX (b) of Invitation for Bids)

Occupation	No. Expected to be Employed	Number of Months Employed
Laborer		
Watchman		
Finishers, Concrete		
Fireman		
Foreman		
Carpenter's Helper		
Concrete Mixer Operator		
Air Compressor Operator		
Crusher Operator		
Grader Operator		
Jackhammer Operator		
Pump Operator		
Tractor Operator		
Truck Operator		
Blacksmith		
Reinforcing Rod Benders of Placers		
Carpenter		
Electrician		
Derrick Operator		
Hoist Operator		
Power Shovel Operator		
Roller Operator		
Mechanics		
Pile Driver Men		

It is hereby warranted that in the event award is made to the undersigned there will be used in the performance of the work covered by the contract only such unmanufactured articles, materials and supplies as have been mined or produced in the United States and only such manufactured articles, materials, and supplies as have been manufactured in the United States all from articles, materials, or supplies, mined, produced or manufactured, as the case may be, in the United States, except as noted below or otherwise indicated in this bid or authorized in the specifications.

The undersigned agrees, upon receipt of written notice of the acceptance of this bid within 60 days after the date of opening of the bids, to execute the standard forms of Government contract, in accordance with the bid as accepted, and to give the required performance and payment bonds, with good and sufficient surety or sureties, for the faithful performance of the contract, and for the protection of all persons supplying labor and materials in the prosecution of the work, within 10 days after the prescribed forms are presented for signature.

Performance will begin within 10 calendar days after the date of receipt of notice to proceed and will be completed within 150 calendar days after date of receipt of said notice to proceed.

_____
(Bidder)

_____
(Address)

By _____
(Name) (Title)